FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 of 1

LLANO COUNTY, TEXAS

AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
CITY OF HORSESHOE BAY	**480149**
CITY OF LLANO	**480451**
CITY OF SUNRISE BEACH VILLAGE	**481531**
LLANO COUNTY UNINCORPORATED AREAS	**481234**

REVISED PRELIMINARY

JANUARY 15, 2015

FEMA

REVISED:

FLOOD INSURANCE STUDY NUMBER
48299CV000B

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FLOOD INSURANCE STUDY REPORT
LLANO COUNTY, TEXAS

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary Federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the Federal Government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60.3, *Criteria for land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after

the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as "Post-FIRM" buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum Federal requirements. Contact your State NFIP Coordinator to ensure that any higher State standards are included in the community's regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Llano County, Texas.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the 8-digit Hydrologic Unit Codes (HUC-8) sub-basins affecting each, are shown in Table 1. The Flood Insurance Rate Map (FIRM) panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

The location of flood hazard data for participating communities in multiple jurisdictions is also indicated in the table.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Llano County, Unincorporated Areas	481234	12090201, 12090204, 12090205,	48299C0025C, 48299C0050C, 48299C0075C, 48299C0100C, 48299C0125C, 48299C0150C, 48299C0175D, 48299C0190D, 48299C0195D, 48299C0200C, 48299C0225D, 48299C0250C, 48299C0275D, 48299C0300D, 48299C0305D, 48299C0310D, 48299C0325C, 48299C0350D, 48299C0375D, 48299C0400C, 48299C0425C, 48299C0450C, 48299C0475C, 48299C0500C, 48299C0510C, 48299C0525C, 48299C0550C, 48299C0575C, 48299C0600C, 48299C0625C, 48299C0650C, 48299C0675C, 48299C0700C	
City of Horseshoe Bay	480149	12090201	48299C0510C, 48299C0525C, 48299C0550C	
City of Llano	480451	12090204	48299C0190D, 48299C0195D, 48299C0305D, 48299C0310D	
City of Sunrise Beach Village	481531	12090201	48299C0510C, 48299C0525C	

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages State and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may

include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1% annual chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1% annual chance and 0.2% annual chance floodplains; and 1% annual chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report. Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 31, "Map Repositories," within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

  The initial Countywide FIS Report for Llano County became effective on May 2, 2012. Refer to Table 28 for information about subsequent revisions to the FIRMs.

- FEMA does not impose floodplain management requirements or special insurance ratings based on Limit of Moderate Wave Action (LiMWA) delineations at this time. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. If the LiMWA is shown on the FIRM, it is being provided by FEMA as information only. For communities that do adopt Zone VE building standards in the area defined by the LiMWA, additional Community Rating System (CRS) credits are available. Refer to Section 2.5.4 for additional information about the LiMWA.

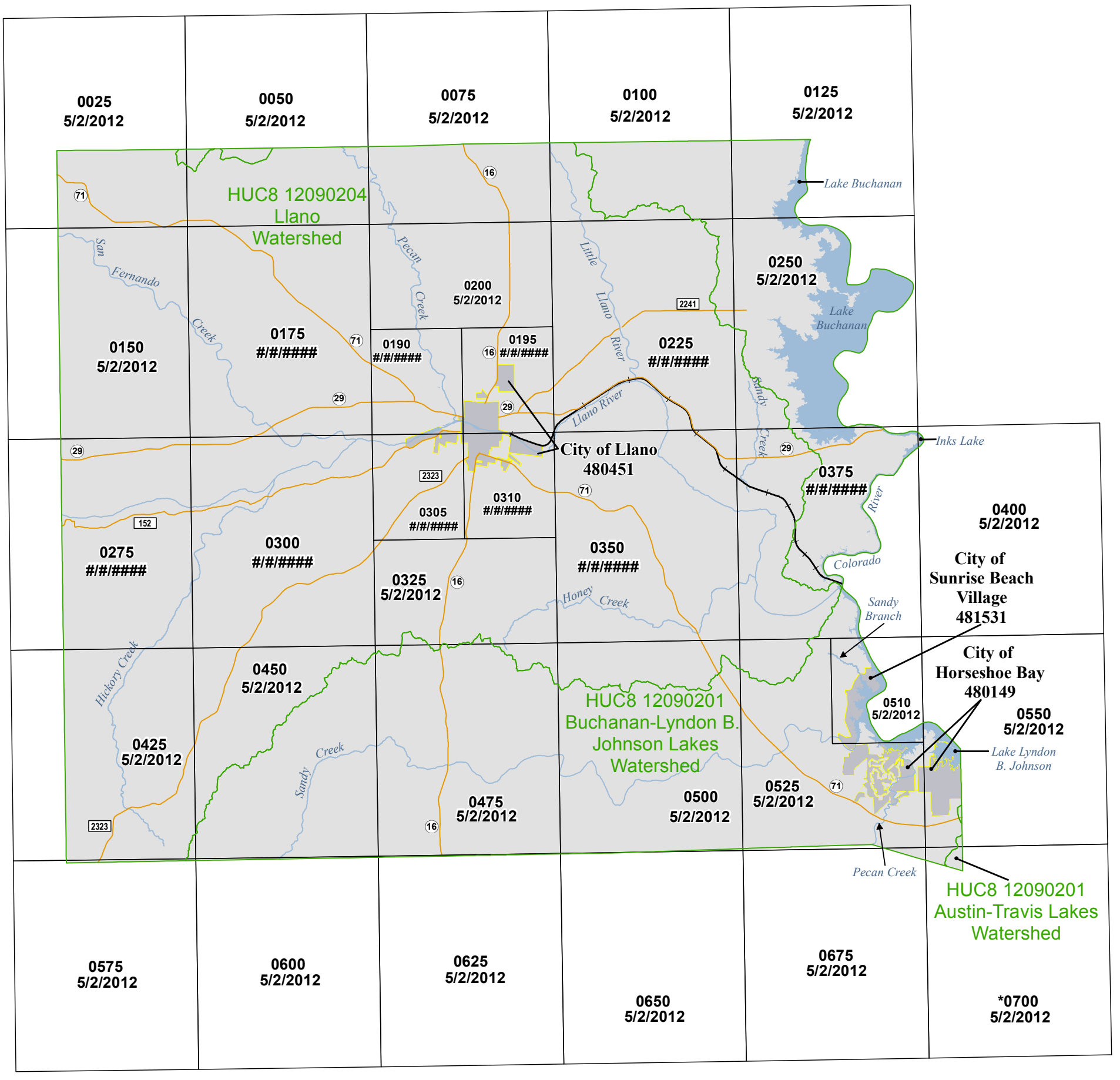
  The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Visit the FEMA Web site at http://www.fema.gov or contact your appropriate FEMA Regional Office for more information about this program.

- Previous FIS Reports and FIRMs may have included levees that were accredited as reducing the risk associated with the 1% annual chance flood based on the information available and the mapping standards of the NFIP at that time. For FEMA to continue to accredit the identified levees, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected

by Levee Systems."

Since the status of levees is subject to change at any time, the user should contact the appropriate agency for the latest information regarding levees presented in Table 9 of this FIS Report. For levees owned or operated by the U.S. Army Corps of Engineers (USACE), information may be obtained from the USACE national levee database. For all other levees, the user is encouraged to contact the appropriate local community.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at http://www.fema.gov.



N

1 in = 5 miles

0 1 2 4 6 8 Miles

Map Projection:
Lambert Conformal Conic
North American Datum 1983

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

*PANEL NOT PRINTED

COUNTY LOCATOR

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

LLANO COUNTY, TEXAS And Incorporated Areas
PANELS PRINTED:

0025, 0050, 0075, 0100, 0125, 0150, 0175, 0190, 0195, 0200, 0225, 0250, 0275, 0300, 0305, 0310, 0325, 0350, 0375, 0400, 0425, 0450, 0475, 0500, 0510, 0525, 0550, 0575, 0600, 0625, 0650, 0675

REVISED PRELIMINARY 1/15/15

FEMA

MAP NUMBER
48299CIND0B
MAP REVISED

Figure 2: FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 28 in this FIS Report.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" of this FIS Report for information on flood control structures for this jurisdiction.

Figure 2. FIRM Notes to Users

PROJECTION INFORMATION: The projection used in the preparation of the map was State Plane Texas Central FIPS Zone 4203 (Feet). The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 31 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided in digital format by Capital Area Council of Governments (CAPCOG), City of Horseshoe Bay, Lower Colorado River Authority (LCRA), National Oceanic and Atmospheric Administration (NOAA) National Geodetic Survey (NGS), Texas Natural Resources Information System (TNRIS), and the United State Geological Survey (USGS). For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Figure 2. FIRM Notes to Users

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Llano County, Texas, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Llano County, Texas**,** effective **MONTH ##, ####.**

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Figure 3: Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: *The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)

Zone A — The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE — The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone, either at cross section locations or as static whole-foot elevations that apply throughout the zone.

Zone AH — The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.

Zone AO — The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.

Zone AR — The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

Zone A99 — The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.

Zone V — The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.

Zone VE — Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.

Regulatory Floodway determined in Zone AE.

Figure 3: Map Legend for FIRM

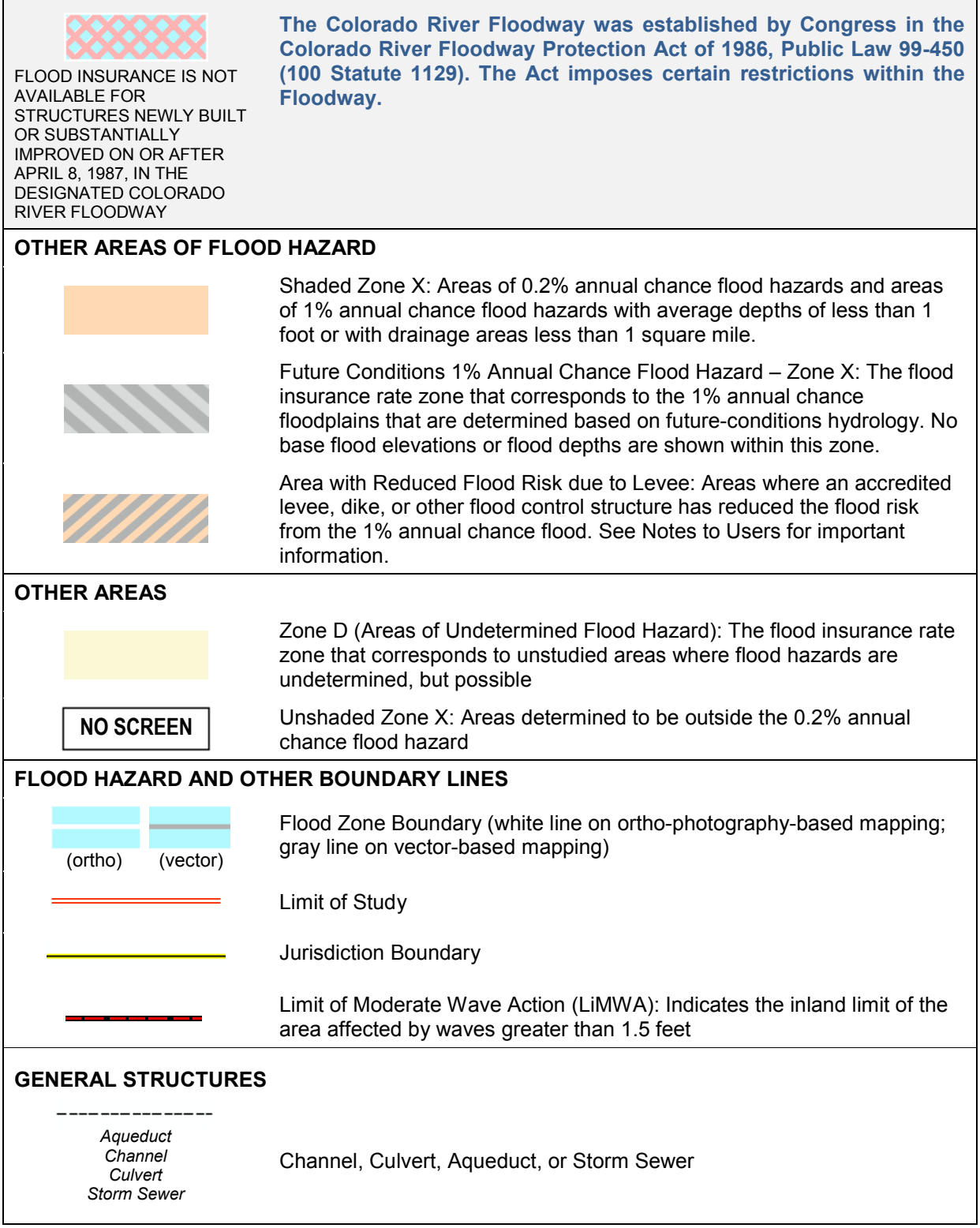


Figure 3: Map Legend for FIRM

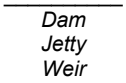
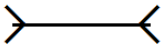
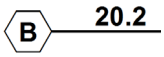
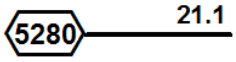
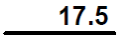
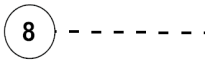
	Dam, Jetty, Weir
	Levee, Dike, or Floodwall accredited or provisionally accredited to reduce the flood risk from the 1% annual chance flood.
	Levee, Dike or Floodwall not accredited to reduce the flood risk from the 1% annual chance flood.
	Bridge
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*	
	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
	Otherwise Protected Area
REFERENCE MARKERS	
	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.

Figure 3: Map Legend for FIRM

513	Base Flood Elevation Line (shown for flooding sources for which no cross sections or profile are available)
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16' 52.5"	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1% annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2% annual chance (500-year) flood is employed to indicate additional areas of flood hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and Llano County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1% annual chance flood elevations; elevations corresponding to other floods (e.g. 10-, 4-, 2-, 0.2-percent annual chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 23), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1% and 0.2% annual chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1% annual chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary is shown on the FIRM. Figure 3, "Map Legend for FIRM", describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Llano County, Texas, respectively.

Table 2, "Flooding Sources Included in this FIS Report," lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1% annual chance floodplain corresponds to the SFHAs. The 0.2% annual chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

2.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the

encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard.

For purposes of the NFIP, a floodway is used as a tool to assist local communities in balancing floodplain development against increasing flood hazard. With this approach, the area of the 1% annual chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1% annual chance flood. The floodway fringe is the area between the floodway and the 1% annual chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water surface elevation of the 1% annual chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, Federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. No floodways were calculated as part of this project.

Figure 4: Floodway Schematic

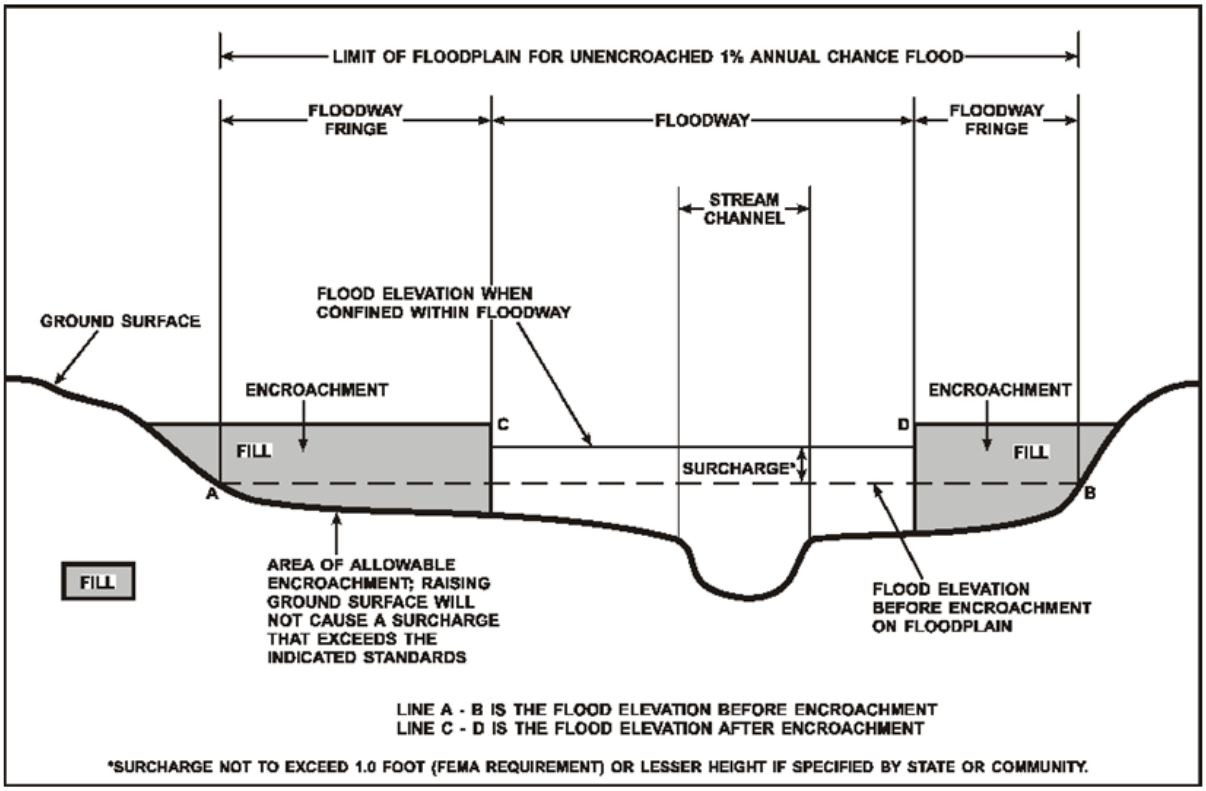


Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Buttery Creek	City of Llano, Llano County	Confluence with Llano River	Approximately 1.8 miles upstream of the confluence with Llano River	12090204	1.8	Not Provided	N	AE	9/15/2011
Buttery Creek Tributary 1	City of Llano, Llano County	Confluence with Buttery Creek	Approximately 1.4 miles upstream of the confluence with Buttery Creek	12090204	1.4	Not Provided	N	AE	9/15/2011
Buttery Creek Tributary 2	City of Llano, Llano County	Confluence with Buttery Creek	Approximately 0.8 mile upstream of the confluence with Buttery Creek	12090204	0.8	Not Provided	N	AE	9/15/2011
Colorado River	City of Horseshoe Bay, City of Sunrise Beach Village, Llano County	Downstream limit of Llano County	San Saba County Boundary	12090201	45.0	Not Provided	N	AE	11/11/2003
Flag Creek	City of Llano, Llano County	Confluence with Llano River	Approximately 1.03 miles upstream of the confluence with Llano River	12090204	1.0	Not Provided	N	AE	9/15/2011
Llano River	City of Llano, Llano County	Approximately 6.2 miles upstream of the confluence with the Colorado River	Mason County Boundary	12090204	38.7	Not Provided	N	AE	9/15/2011

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Llano River	Llano County	Confluence with Colorado River	Approximately 6.2 miles upstream of the confluence with the Colorado River	12090204	6.2	Not Provided	N	AE	11/11/2003
Various Streams Studied by Approximate Methods	City of Horseshoe Bay, City of Llano, City of Sunrise Beach Village, Llano County	Not Provided	Not Provided	12090204, 12090201	Not Provided	Not Provided	N	A	11/11/2003

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (BFE) is the elevation of the 1% annual chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. BFEs are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM.

2.4 Non-Encroachment Zones

Some States and communities use non-encroachment zones to manage floodplain development. For flooding sources with medium flood risk, field surveys are often not collected and surveyed bridge and culvert geometry is not developed. Standard hydrologic and hydraulic analyses are still performed to determine BFEs in these areas. However, floodways are not typically determined, since specific channel profiles are not developed. To assist communities with managing floodplain development in these areas, a "non-encroachment zone" may be provided. While not a FEMA designated floodway, the non-encroachment zone represents that area around the stream that should be reserved to convey the 1% annual chance flood event. As with a floodway, all surcharges must fall within the acceptable range in the non-encroachment zone.

General setbacks can be used in areas of lower risk (e.g. unnumbered Zone A), but these are not considered sufficient where unnumbered Zone A is replaced by Zone AE. The NFIP requires communities to ensure that any development in a non-encroachment area causes no increase in BFEs. Communities must generally prohibit development within the area defined by the non-encroachment width to meet the NFIP requirement.

Non-encroachment determinations may be delineated where it is not possible to delineate floodways because specific channel profiles with bridge and culvert geometry were not developed. Any non-encroachment determinations for this FIS project have been tabulated for selected cross sections and are shown in Table 25, "Flood Hazard and Non-Encroachment Data for Selected Streams." Areas for which non-encroachment zones are provided show BFEs and the 1% annual chance floodplain boundaries mapped as zone AE on the FIRM but no floodways.

2.5 Coastal Flood Hazard Areas

2.5.1 Water Elevations and the Effects of Waves

This section is not applicable to this FIS project.

Figure 5: Wave Runup Transect Schematic

[Not applicable to this FIS project]

2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

This section is not applicable to this FIS project.

2.5.3 Coastal High Hazard Areas

This section is not applicable to this FIS project.

Figure 6: Coastal Transect Schematic

[Not applicable to this FIS project]

2.5.4 Limit of Moderate Wave Action

This section is not applicable to this FIS project.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, "Map Legend for FIRM." Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1% annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2% annual chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in the unincorporated and incorporated areas of Llano County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Llano County, Unincorporated Areas	A, AE, X
City of Horseshoe Bay	A, AE, X
City of Llano	A, AE, X
City of Sunrise Beach Village	A, AE, X

3.2 Coastal Barrier Resources System

The section is not applicable to this FIS project.

Table 4: Coastal Barrier Resources System Information

[Not applicable to this FIS project]

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 5 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Austin-Travis Lakes	12090205	Colorado River	Begins just upstream of Alvin Wirtz Dam, extends southeast, affecting a small area of the southeastern corner of Llano County	1240.9
Buchanan-Lyndon B. Johnson Lakes	12090201	Colorado River	Begins at confluence with Colorado River and San Saba River, extends south, affecting the eastern edge of Llano County	1270.0
Llano	12090204	Llano River	Begins at confluence with Llano River, extends west, affecting most of Llano County	2613.8

4.2 Principal Flood Problems

Table 6 contains a description of the principal flood problems that have been noted for Llano County by flooding source.

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
All sources	Llano County has experienced loss of physical property and human life as a result of flooding along its major waterways. Development subject to flood damage consists primarily of well-built modern residences or older, more modest houses. There are also some commercial and light industrial

Flooding Source	Description of Flood Problems
	establishments that are subject to flooding, especially near the major road crossings. Some undersized bridges and low-water crossings are constrictions to flood flow and contribute flooding problems. Heavy rainfall from storms along weather fronts is the major cause of flooding, primarily during the spring and summer months. Major flooding can be produced by the intense rainfall usually associated with localized thunderstorms. These thunderstorms may occur at any time during the year, but are more prevalent in the spring and summer months. On June 22, 1997 a storm occurred throughout South Central Texas. The heavy rain Friday night into Saturday afternoon had left South Central Texas soils saturated. The situation worsened Saturday evening into Sunday as heavy rain associated with the upper low pressure system redeveloped over the western Texas Hill Country. Very heavy rains over the Texas Hill Country Saturday night and Sunday morning caused widespread flooding as well as flash flooding across numerous counties. Tremendous flow down the James River, reinforced by 8 to 15 inch rainfall east of Mason Sunday afternoon and evening sent the Llano River at Llano to over 38 feet shortly near midnight Sunday night, some 6 feet above the 1952 flood of record. Several buildings and a dozen homes were flooded in Llano, and major damage was reported to the city park. At least two dozen homes were flooded between Llano and Castell and 5 to 6 homes flooded south of Llano. At Kingsland, complete destruction was reported to docks along the River above Lake LBJ. Most boats were destroyed, although no homes were flooded. Along the Colorado River, over a dozen homes and lodges were flooded. Flooding along lake Marble Falls, on the north side of Lake LBJ, involved some 35 homes on one side alone. At Lake Marble Falls, inflow was so great that the lake volume was being replaced every 12 minutes on Sunday evening. Total estimates of the damages were placed at $5,000,000.

Table 7 contains information about historic flood elevations in the communities within Llano County.

Table 7: Historic Flooding Elevations

[Not applicable to this FIS project]

4.3 Non-Levee Flood Protection Measures

Table 8 contains information about non-levee flood protection measures within Llano County such as dams, jetties, and or dikes. Levees are addressed in Section 4.4 of this FIS Report.

Table 8: Non-Levee Flood Protection Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Colorado River	Alvin Wirtz Dam	Dam	On Lake Lyndon B. Johnson	Completed in 1951, owned and operated by the Lower Colorado River Authority

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Colorado River	Buchanan Dam	Dam	Between Burnet and Llano Counties	Lake Buchanan has a capacity of 992,000 acre-feet
Colorado River	Mansfield Dam	Dam	Ten miles northwest of Austin	Lake Travis has a capacity of 1,950,000 acre-feet
Colorado River	Max Starke Dam	Dam	Upper end of Lake Travis	Lake Marble Falls has a capacity of 8,760 acre-feet
Colorado River	Roy Inks Dam	Dam	Ten miles west of the City of Burnet	Inks lake has a capacity of 17,000 acre-feet
Colorado River	Tom Miller Dam	Dam	Western edge of the Austin corporate limits	Lake Austin has a capacity of 20,000 acre-feet

4.4 Levees

The section is not applicable to this FIS project.

Table 9: Levees

[Not applicable to this FIS project]

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded at least once on the average during any 10-, 25-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2% annual chance, respectively, of being equaled or exceeded during any year.

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 27, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, “FIRM Revisions.”

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 13. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 10. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 11. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 17.) Stream gage information is provided in Table 12.

Table 10: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Buttery Creek	Confluence with Buttery Creek Tributary 1	2.26	*	*	*	4,730	*	*
Buttery Creek	At State Highway 29	1.60	*	*	*	3,325	*	*
Buttery Creek	At Collins Street	0.72	*	*	*	1,590	*	*
Buttery Creek Tributary 1	At Chattanooga Drive	0.55	*	*	*	1,280	*	*
Buttery Creek Tributary 1	At Sheffield Road	0.49	*	*	*	1,200	*	*
Buttery Creek Tributary 1	At Leon Road	0.26	*	*	*	780	*	*
Buttery Creek Tributary 2	At Collins Street	0.30	*	*	*	770	*	*
Colorado River	At Max Starke Dam	12,900	159,000	*	322,500	365,700	*	528,400
Colorado River	At Alvin Wirtz Dam	12,800	163,100	*	323,600	367,600	*	532,200
Colorado River	At Roy Inks Dam	7,900	56,500	*	128,000	157,000	*	308,000
Flag Creek	At Highway 152	11.40	*	*	*	9,390	*	*
Llano River	Confluence with the Colorado River	4,460	104,147	*	242,109	307,143	*	423,395

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance Existing	1% Annual Chance Future	0.2% Annual Chance
Llano River	1,500 ft. downstream of FM 3404	4,403	*	*	*	380,000	*	*
Llano River	At USGS Gauge 08151500	4,197	*	*	*	380,000	*	*
Llano River	At Mason/Llano County Line	3,640	*	*	*	380,000	*	*

*Not calculated for this FIS project

Figure 7: Frequency Discharge-Drainage Area Curves

[Not applicable to this FIS project]

Table 11: Summary of Non-Coastal Stillwater Elevations

[Not applicable to this FIS project]

Table 12: Stream Gage Information used to Determine Discharges

[Not applicable to this FIS project]

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed on Table 24, “Floodway Data.”

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 13. Roughness coefficients are provided in Table 14. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 13: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits		Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
	Downstream Limit	Upstream Limit					
Buttery Creek	Confluence with Llano River	Approximately 1.8 miles upstream of the confluence with Llano River	HEC-HMS 3.4	HEC-RAS 4.1.0	09/15/2011	AE	None
Buttery Creek Tributary 1	Confluence with Buttery Creek	Approximately 1.4 miles upstream of the confluence with Buttery Creek	HEC-HMS 3.4	HEC-RAS 4.1.0	09/15/2011	AE	None
Buttery Creek Tributary 2	Confluence with Buttery Creek	Approximately 0.8 mile upstream of the confluence with Buttery Creek	HEC-HMS 3.4	HEC-RAS 4.1.0	09/15/2011	AE	None
Colorado River	Downstream limit of Llano County	San Saba County Boundary	HEC-HMS	HEC-RAS	11/11/2003	AE	None
Flag Creek	Confluence with Llano River	Approximately 1.03 miles upstream of the confluence with Llano River	HEC-HMS 3.4	HEC-RAS 4.1.0	09/15/2011	AE	None
Llano River	Approximately 6.2 miles upstream of the confluence with the Colorado River	Mason County Boundary	Gage Analysis	HEC-RAS 4.1.0	09/15/2011	AE	Revised from 1,450 feet downstream of FM 3404 to the Mason/Llano County line due to LOMR 12-06-0160P

Flooding Source	Study Limits		Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
	Downstream Limit	Upstream Limit					
Llano River	Confluence with the Colorado River	Approximately 6.2 miles upstream of the confluence with the Colorado River	NUDALLAS	HEC-RAS, HEC-2, HEC-5	11/11/2003	AE	None
Various Streams Studied by Approximate Methods	Not Provided	Not Provided	Not Provided	Not Provided	11/11/2003	A	None

Table 14: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Buttery Creek	0.05-0.065	0.065-0.12
Buttery Creek Tributary 1	0.02-0.055	0.04-0.09
Buttery Creek Tributary 2	0.04-0.06	0.06-0.12
Colorado River	0.025	0.030-0.095
Flag Creek	0.055-0.065	0.08-0.12
Llano River	0.019-0.065	0.019-0.065

5.3 Coastal Analyses

This section is not applicable to this FIS project.

Table 15: Summary of Coastal Analyses

[Not applicable to this FIS project]

5.3.1 Total Stillwater Elevations

This section is not applicable to this FIS project.

Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas

[Not applicable to this FIS project]

Table 16: Tide Gage Analysis Specifics

[Not applicable to this FIS project]

5.3.2 Waves

This section is not applicable to this FIS project.

5.3.3 Coastal Erosion

This section is not applicable to this FIS project.

5.3.4 Wave Hazard Analyses

This section is not applicable to this FIS project.

Table 17: Coastal Transect Parameters

[Not applicable to this FIS project]

Figure 9: Transect Location Map

[Not applicable to this FIS project]

5.4 Alluvial Fan Analyses

This section is not applicable to this FIS project.

Table 18: Summary of Alluvial Fan Analyses

[Not applicable to this FIS project]

Table 19: Results of Alluvial Fan Analyses

[Not applicable to this FIS project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

All FIS Reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS Reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS Reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS Report and on the FIRMs are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between NGVD29 and NAVD88 or other datum conversion, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the archived project documentation associated with the FIS Report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks in the area, please contact information services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for Llano County are provided in Table 20.

Table 20: Countywide Vertical Datum Conversion

[Not applicable to this FIS project]

Table 21: Stream-by-Stream Vertical Datum Conversion

[Not applicable to this FIS project]

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA's FIRM database specifications and geographic information standards. This information is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community. The FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA's *Guidelines and Standards for Mapping Partners*, Appendix L.

Base map information shown on the FIRM was derived from the sources described in Table 22.

Table 22: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
USGS 7.7-Minute Series Topographic Maps	United States Geological Survey (USGS)	1989	1:24,000	Spatial and attribute information for the index of USGS 7.5-Minute Series Topographic Map boundaries.
Permanent Bench Mark Data Sheets	NOAA National Geodetic Survey	2002	1:12,000	Spatial and attribute information for permanent benchmarks.
CAPCOG Roads	Capital Area Council of Governments (CAPCOG)	2007	1:24,000	Spatial and attribute information for street centerlines.
Stratmap County Boundary	Texas Natural Resources Information System (TNRIS)	2005	1:24,000	Spatial and attribute information for the County Boundary of Llano County, Texas.
CAPCOG City Limits	Capital Area Council of Governments (CAPCOG)	2007	1:24,000	Spatial and attribute information for city limit boundaries.
Railroads	Capital Area Council of Governments (CAPCOG)	2002	1:24,000	Spatial and attribute information for railroad centerline data.
USGS National Hydrography Dataset	United States Geological Survey (USGS)	2005	1:24,000	Spatial and attribute information for stream centerlines and water bodies.

Data Type	Data Provider	Data Date	Data Scale	Data Description
City Limits of Horseshoe Bay	City of Horseshoe Bay, Texas	2007	1:24,000	Spatial and attribute information for the political boundary of the City of Horseshoe Bay.
Airport, Airfield, Runway, Transportation	Capital Area Council of Governments (CAPCOG)	2004	1:6,000	Spatial and attribute information for airports in Llano County.
LiDAR and Contours	Lower Colorado River Authority (LCRA)	2007	1:2,400	Spatial and attribute information for ground elevations.

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23.

In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The floodway widths presented in this FIS Report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 24, “Floodway Data.”

Certain flooding sources may have been studied that do not have published BFEs on the FIRMs, or for which there is a need to report the 1% annual chance flood elevations at selected cross sections because a published Flood Profile does not exist in this FIS Report. These streams may have also been studied using methods to determine non-encroachment zones rather than floodways. For these flooding sources, the 1% annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 23. All topographic data used for modeling or mapping has been converted as necessary to NAVD 88. The 1% annual chance elevations for selected cross sections along these flooding sources, along with their non-encroachment widths, if calculated, are shown in Table 25, “Flood Hazard and Non-Encroachment Data for Selected Streams.”

Table 23: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data			
		Description	Scale	Contour Interval	Citation
City of Horseshoe Bay, City of Llano, City of Sunrise Beach Village, Llano County	All studied streams within this FIS project	Contours derived from LiDAR	1:2,400	2 ft	LCRA 2007

BFEs shown at cross sections on the FIRM represent the 1% annual chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report.

Table 24: Floodway Data

[Not applicable to this FIS project]

Non-encroachment areas may be delineated where it is not possible to delineate floodways because specific channel profiles with bridge and culvert geometry were not developed. Any non-encroachment determinations for this FIS project have been tabulated for selected cross sections and are shown in Table 25. The non-encroachment width indicates the measured distance left and right (looking downstream) from the mapped center of the stream to the non-encroachment boundary based on a surcharge of 1.0 foot or less.

Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams

[Not applicable to this FIS project]

6.4 Coastal Flood Hazard Mapping

This section is not applicable to this FIS project.

Table 26: Summary of Coastal Transect Mapping Considerations

[Not applicable to this FIS project]

6.5 FIRM Revisions

This FIS Report and the FIRM are based on the most up-to-date information available to FEMA at the time of its publication; however, flood hazard conditions change over time. Communities or private parties may request flood map revisions at any time. Certain types of requests require submission of supporting data. FEMA may also initiate a revision. Revisions to FIS projects may take several forms, including Letters of Map Amendment (LOMAs), Letters of Map Revision Based on Fill (LOMR-Fs), Letters of Map Revision (LOMRs) (referred to collectively as Letters of Map Change (LOMCs)), Physical Map Revisions (PMRs), and FEMA-contracted restudies. These types of revisions are further described below. Some of these types of revisions do not result in the republishing of the FIS Report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data (shown in Table 31, "Map Repositories").

6.5.1 Letters of Map Amendment

A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative process that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in a SFHA. A LOMA cannot be issued for properties located on the PFD (primary frontal dune).

To obtain an application for a LOMA, visit http://www.fema.gov and download the form "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill". Visit the "Flood Map-Related Fees" section to determine the cost, if any, of applying for a LOMA.

FEMA offers a tutorial on how to apply for a LOMA. The LOMA Tutorial Series can be accessed at http://www.fema.gov/plan/prevent/fhm/ot_lmreq.shtm.

For more information about how to apply for a LOMA, call the FEMA Map Information

eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627).

6.5.2 Letters of Map Revision Based on Fill

A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the base flood elevation and is, therefore, excluded from the SFHA.

Information about obtaining an application for a LOMR-F can be obtained in the same manner as that for a LOMA, by visiting http://www.fema.gov for the "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill" or by calling the FEMA Map Information eXchange, toll free, at 1-877-FEMA MAP (1-877-336-2627). Fees for applying for a LOMR-F, if any, are listed in the "Flood Map-Related Fees" section.

A tutorial for LOMR-F is available at http://www.fema.gov/plan/prevent/fhm/ot_lmreq.shtm.

6.5.4 Letters of Map Revision

A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations and planimetric features. All requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

To obtain an application for a LOMR, visit http://www.fema.gov and download the form "MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision". Visit the "Flood Map-Related Fees" section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

Previously issued mappable LOMCs (including LOMRs) that have been incorporated into the Llano County FIRM are listed in Table 27.

Table 27: Incorporated Letters of Map Change

Case Number	Effective Date	Flooding Source	FIRM Panel(s)
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0175D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0190D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0195D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0225D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0275D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0300D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0305D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0310D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0350D
12-06-0160P	*	Buttery Creek, Buttery Creek Tributary 1, Buttery Creek Tributary 2, Flag Creek, Llano River	48299C0375D

*This is a 316-LOMR that is being incorporated into this FIS Project and will become effective when this FIS Project becomes effective.

6.5.3 Physical Map Revisions

PMRs are an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit http://www.fema.gov and visit the "Flood Map Revision Processes" section.

6.5.4 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA

to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.5 Community Map History

The current FIRM presents flooding information for the entire geographic area of Llano County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 28, "Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.

- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first Flood Hazard Boundary Map (FHBM). This date may be the same date as the Initial NFIP Map Date.

- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.

- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community. This is the first effective date that is shown on the FIRM panel.

- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as Physical Map Revisions (PMR) of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Llano County FIRMs in countywide format was 05/02/2012.

Table 28: Community Map History

Community Name	Initial Identification Date (First NFIP Map Published)	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Horseshoe Bay, City of	09/18/1991	N/A	N/A	09/18/1991	05/02/2012
Llano, City of	12/28/1973	12/28/1973	06/11/1976	05/04/1982	05/02/2012
Llano County Unincorporated Areas	11/22/1977	11/22/1977	N/A	09/18/1991	05/02/2012
Sunrise Beach Village, City of	06/19/1979	06/19/1979	N/A	09/27/1991	05/02/2012

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 29 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 29: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Buttery Creek	*	RAMPP	HSFEHQ-09-D-0369	09/15/2011	City of Llano
Buttery Creek Tributary 1	*	RAMPP	HSFEHQ-09-D-0369	09/15/2011	City of Llano
Buttery Creek Tributary 2	*	RAMPP	HSFEHQ-09-D-0369	09/15/2011	City of Llano
Colorado River	05/02/2012	Halff Associates Inc.	Not Provided	11/11/2003	City of Horseshoe Bay, City of Sunrise Beach Village, Llano County Unincorporated Areas
Flag Creek	*	RAMPP	HSFEHQ-09-D-0369	09/15/2011	City of Llano
Llano River	*	RAMPP	HSFEHQ-09-D-0369	09/15/2011	City of Llano, Llano County Unincorporated Areas

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Llano River	05/02/2012	Halff Associates Inc.	Not Provided	11/11/2003	Llano County Unincorporated Areas
Various Streams Studied by Approximate Methods	05/02/2012	Halff Associates Inc.	Not Provided	11/11/2003	City of Horseshoe Bay, City of Sunrise Beach Village, Llano County Unincorporated Areas

*Will be updated upon effective issuance of this FIS Project.

7.2 Community Meetings

The dates of the community meetings held for this FIS project and any previous FIS projects are shown in Table 30. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 30: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Llano County and Incorporated Areas	05/02/2012	05/01/2007	Initial CCO	FEMA, City of Llano, Llano County, Lower Colorado River Authority, City of Horseshoe Bay, City of Sunrise Beach, TXDOT and Halff Associates Inc.
		09/25/2009	Final CCO	FEMA, Llano County, City of Sunrise Beach, City of Horseshoe Bay, City of Llano, Texas Association of Counties and Halff Associates, Inc.

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see http://www.fema.gov.

The additional data that was used for this project includes the FIS Report and FIRM that were previously prepared for Llano County and the Incorporated Areas of the Cities of Horseshoe Bay, Llano, and Sunrise Beach Village (FEMA 2012).

Table 31 is a list of the locations where FIRMs for Llano County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 31: Map Repositories

Community	Address	City	State	Zip Code
Llano County, Unincorporated Areas	100 West Sandstone Street Suite 200A	Llano	TX	78643
City of Horseshoe Bay	1 Community Drive	Horseshoe Bay	TX	78657
City of Llano	301 West Main Street	Llano	TX	78643
City of Sunrise Beach Village	124 Sunrise Drive	Sunrise Beach Village	TX	78643

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM databases and LOMCs. Together they create a GIS data layer for a State or Territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 32.

Table 32 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the state NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of State or territorial government to coordinate that State's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of state and local GIS data in their state.

Table 32: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	http://www.fema.gov
NFIP website	http://www.fema.gov/business/nfip

NFHL Dataset	http://msc.fema.gov
FEMA Region VI	RAMPP Regional Support Center 6, 723 S. Interstate 35E, Suite 230, Denton, TX 76205 (940) 735-3334
Other Federal Agencies	
USGS website	http://www.usgs.gov
Hydraulic Engineering Center website	http://www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Michael Segner Texas Water Development Board 1700 North Congress Avenue P.O. Box 13231 Austin, TX 78711-3231 512-463-3509 michael.segber@twdb.state.tx.us
State GIS Coordinator	Mike Ouimet Statewide GIS Coordinator 300 West 15th Street P.O. Box 13564 Austin, Texas 78711-3564 512-305-9076 mike.ouimet@dir.state.tx.us Rob Aanstoos State GIS Coordinator 300 West 15th Street P.O. Box 13564 Austin, Texas 78711-3564 512-463-7314 Rob.aanstoos@dir.state.tx.us

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 33 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 33: Bibliography and References

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
CAPCOG 2002	Capital Area Council of Governments (CAPCOG)	*Railroads*	Capital Area Council of Governments (CAPCOG)	Austin, Texas	2002	
CAPCOG 2004	Capital Area Council of Governments (CAPCOG)	*Airport, Airfield, Runway, Transportation*	Capital Area Council of Governments (CAPCOG)	Austin, Texas	2004	
CAPCOG 2007-3	Capital Area Council of Governments (CAPCOG)	*CAPCOG Roads*	Capital Area Council of Governments (CAPCOG)	Austin, Texas	2007	
CAPCOG 2007-5	Capital Area Council of Governments (CAPCOG)	*CAPCOG City Limits*	Capital Area Council of Governments (CAPCOG)	Austin, Texas	2007	
CHB 2007	City of Horseshoe Bay, Texas	*City Limits of Horseshoe Bay*	City of Horseshoe Bay, Texas	City of Horseshoe Bay, Texas	2007	
FEMA 2012	Federal Emergency Management Agency (FEMA)	*Flood Insurance Study for Llano County, Texas and Incorporated Areas*	Federal Emergency Management Agency (FEMA)	Washington, D.C.	May 2nd, 2012	

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 2014	Federal Emergency Management Agency (FEMA)	*Incorporation of LOMR Case No. 12-06-0160P*	Federal Emergency Management Agency (FEMA)	Washington, D.C.	TBD	
LCRA 2007	Lower Colorado River Authority (LCRA)	*LiDAR and Contours*	Lower Colorado River Authority (LCRA)	Austin, Texas	2007	
NGS 2002	NOAA National Geodetic Survey	*Permanent Bench Mark Data Sheets*	NOAA	Silver Springs, Maryland	2002	
TNRIS 2005	Texas Natural Resources Information System (TNRIS)	*Stratmap County Boundary*	Texas Natural Resources Information System (TNRIS)	Austin, Texas	2005	
USGS 1989	United States Geological Survey (USGS)	*USGS 7.5-Minute Series Topographic Maps*	United States Geological Survey (USGS)	Reston, Virginia	1989	
USGS 2005	United States Geological Survey (USGS)	*USGS National Hydrography Dataset*	United States Geological Survey (USGS)	Reston, Virginia	2005	

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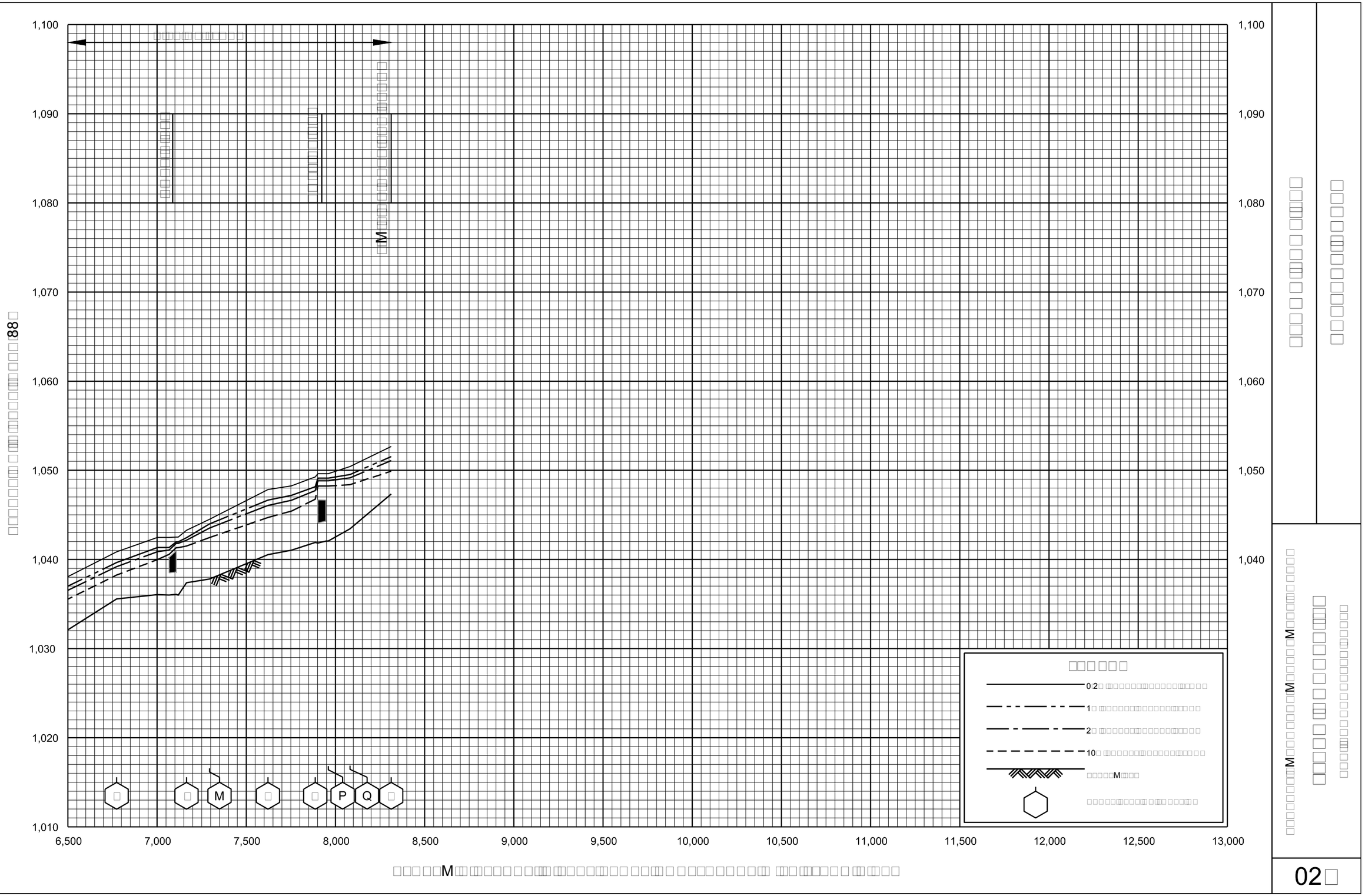
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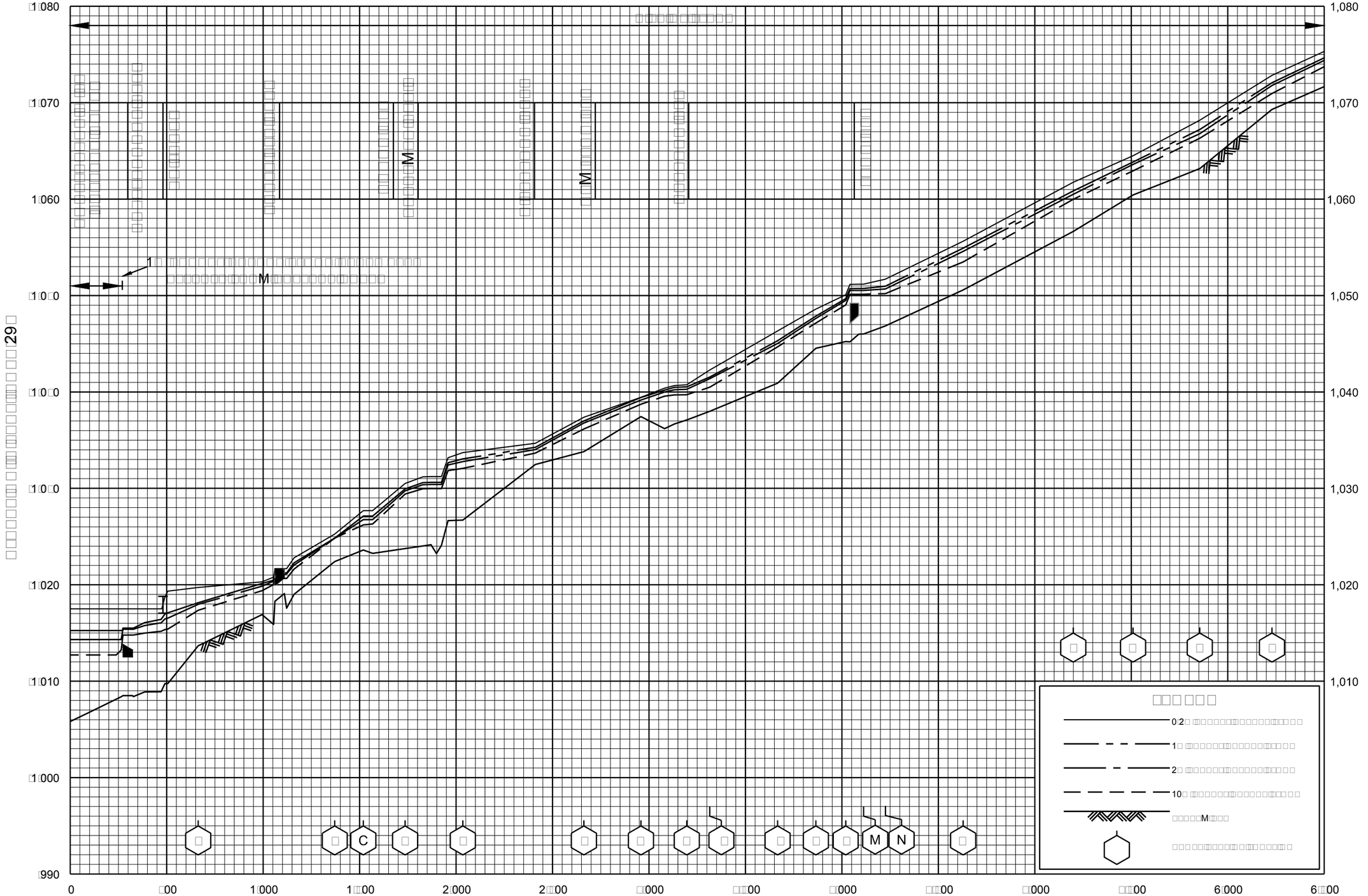
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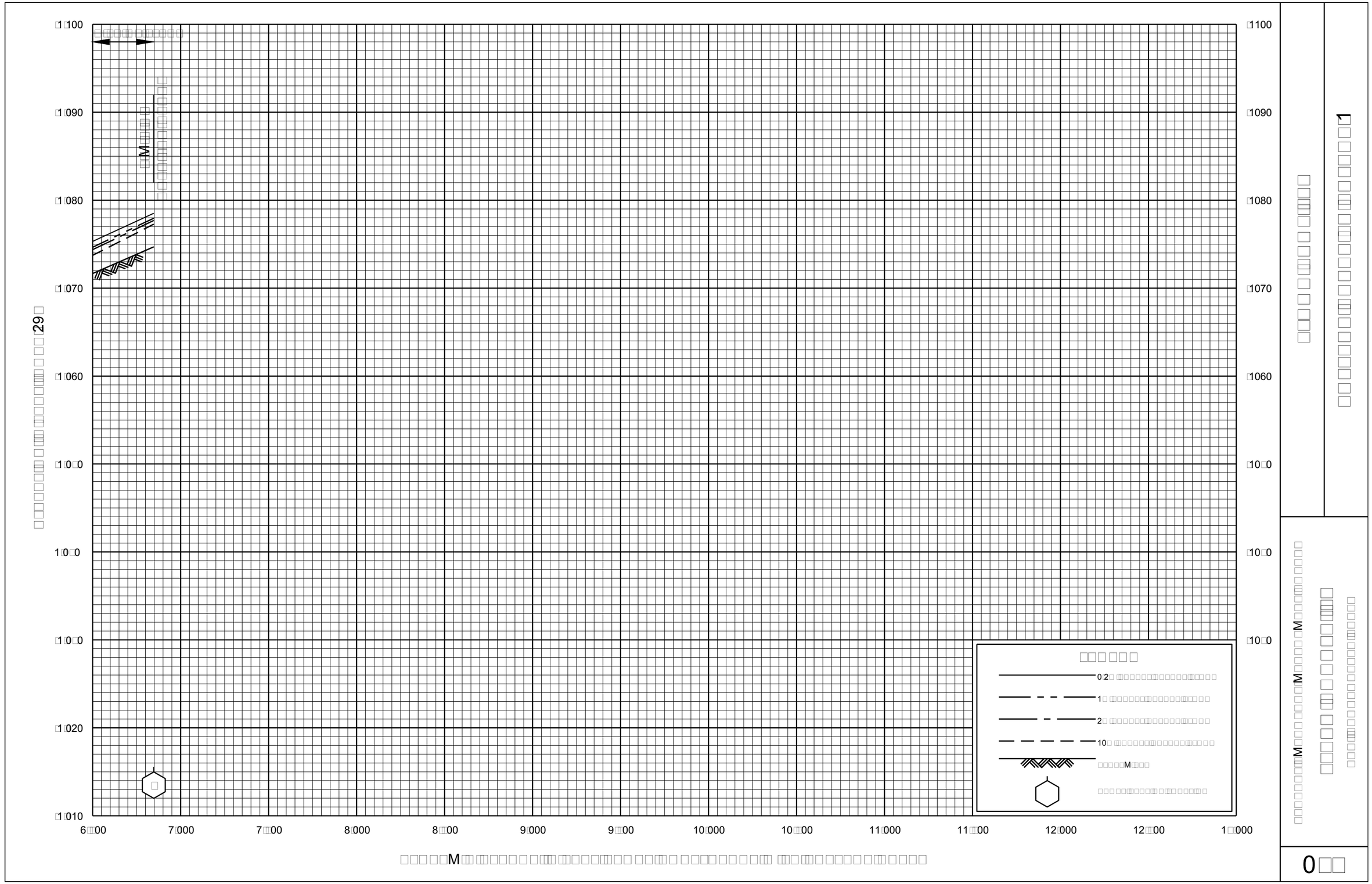
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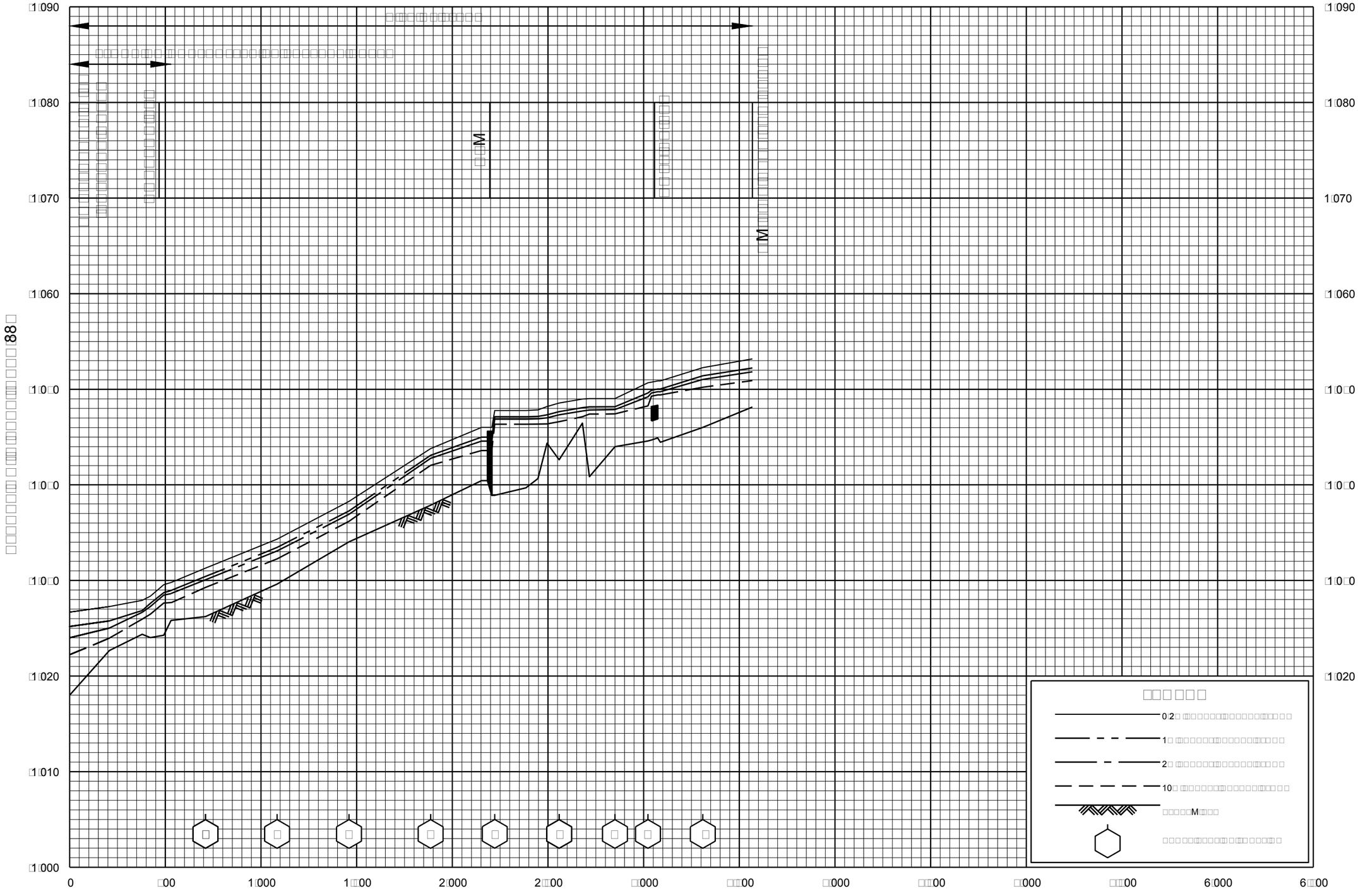
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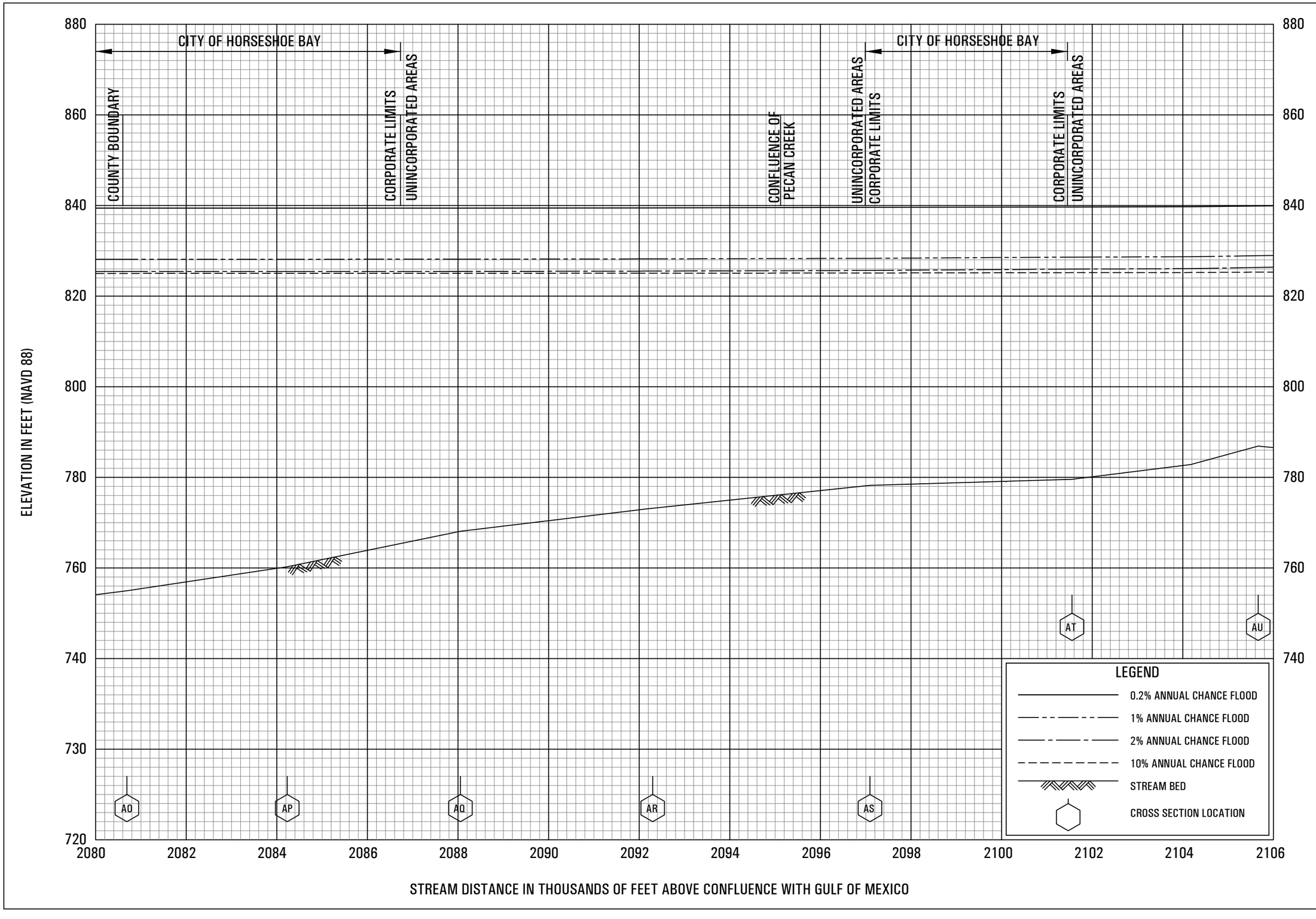

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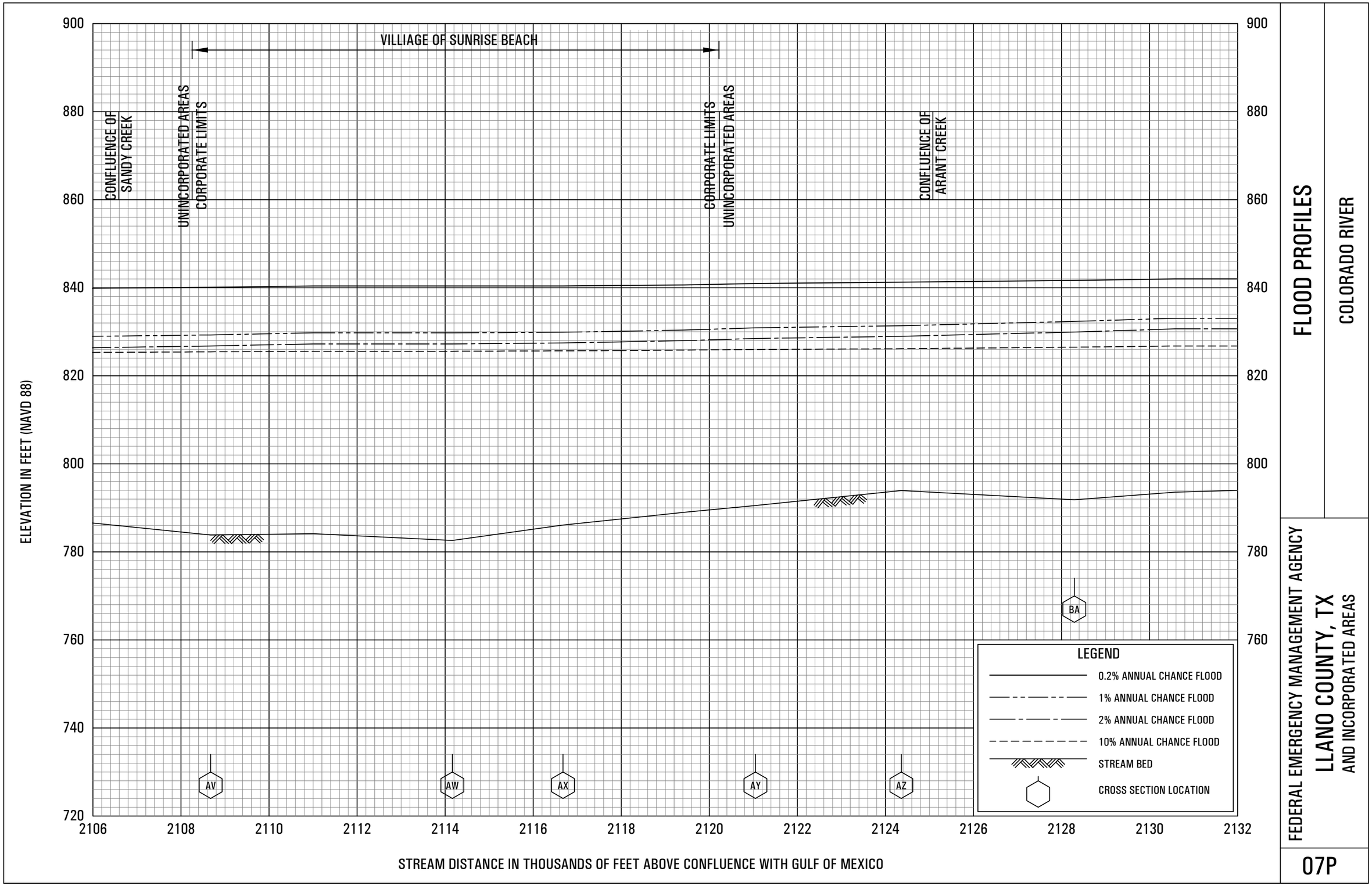

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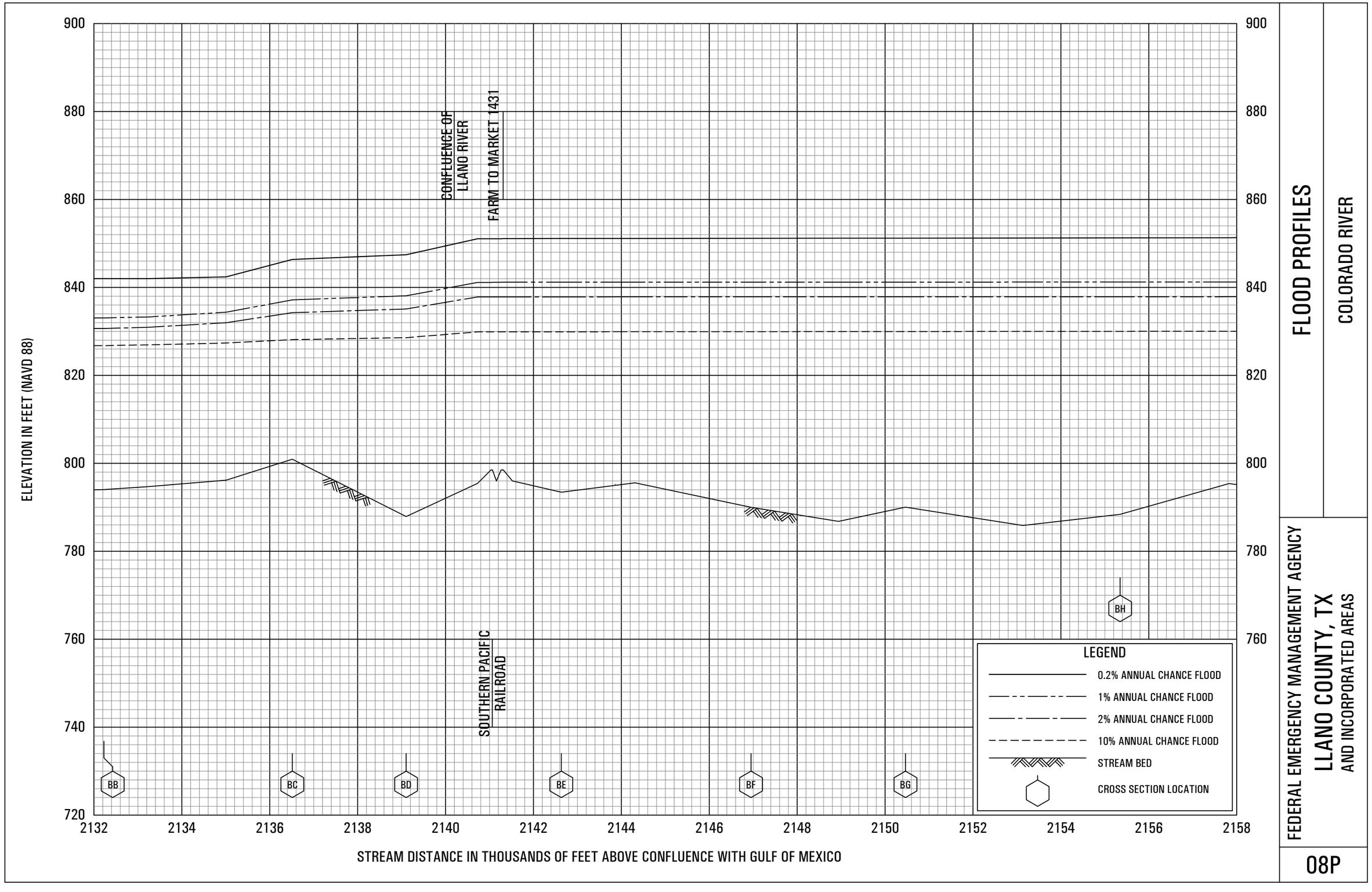

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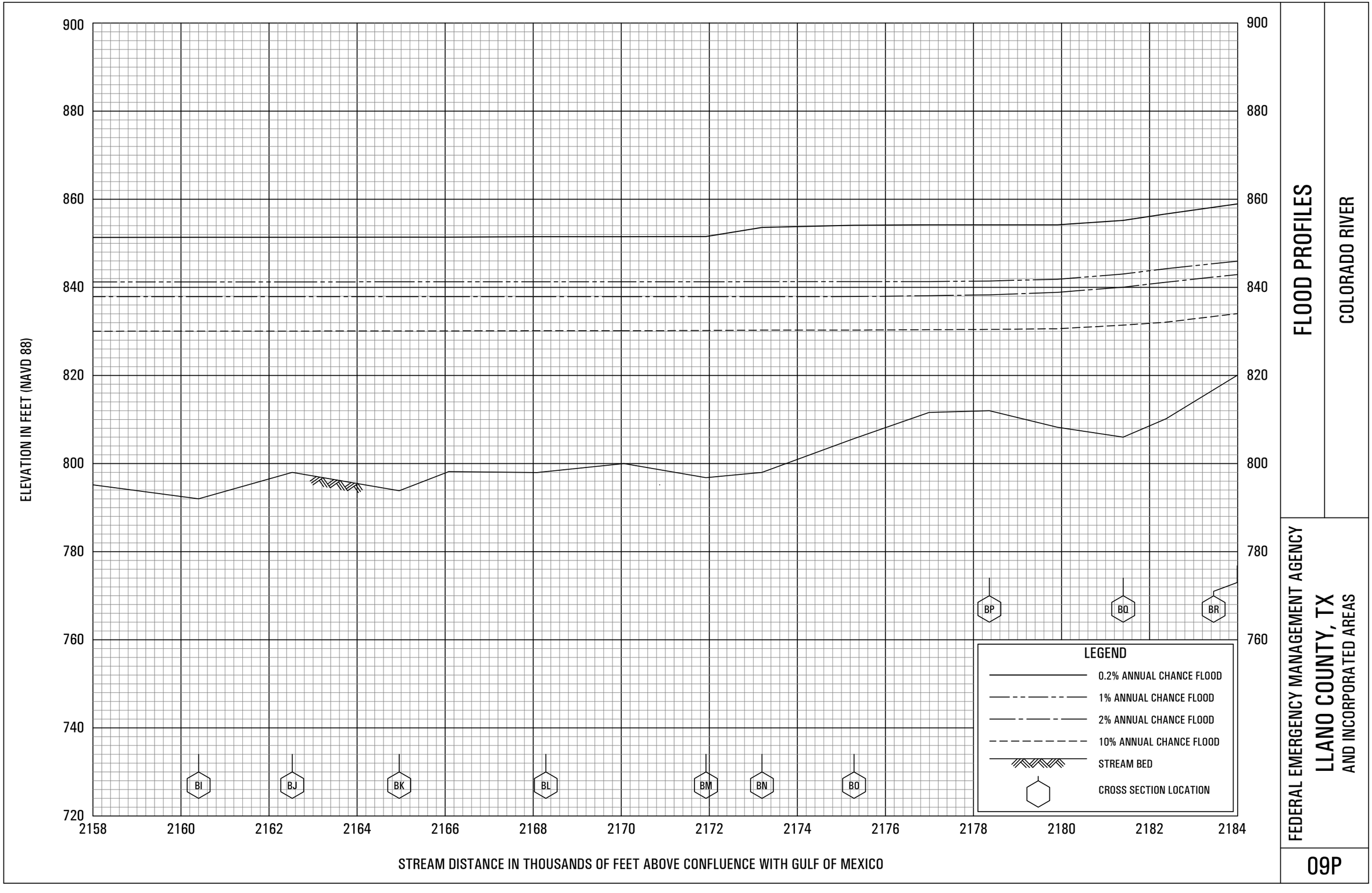

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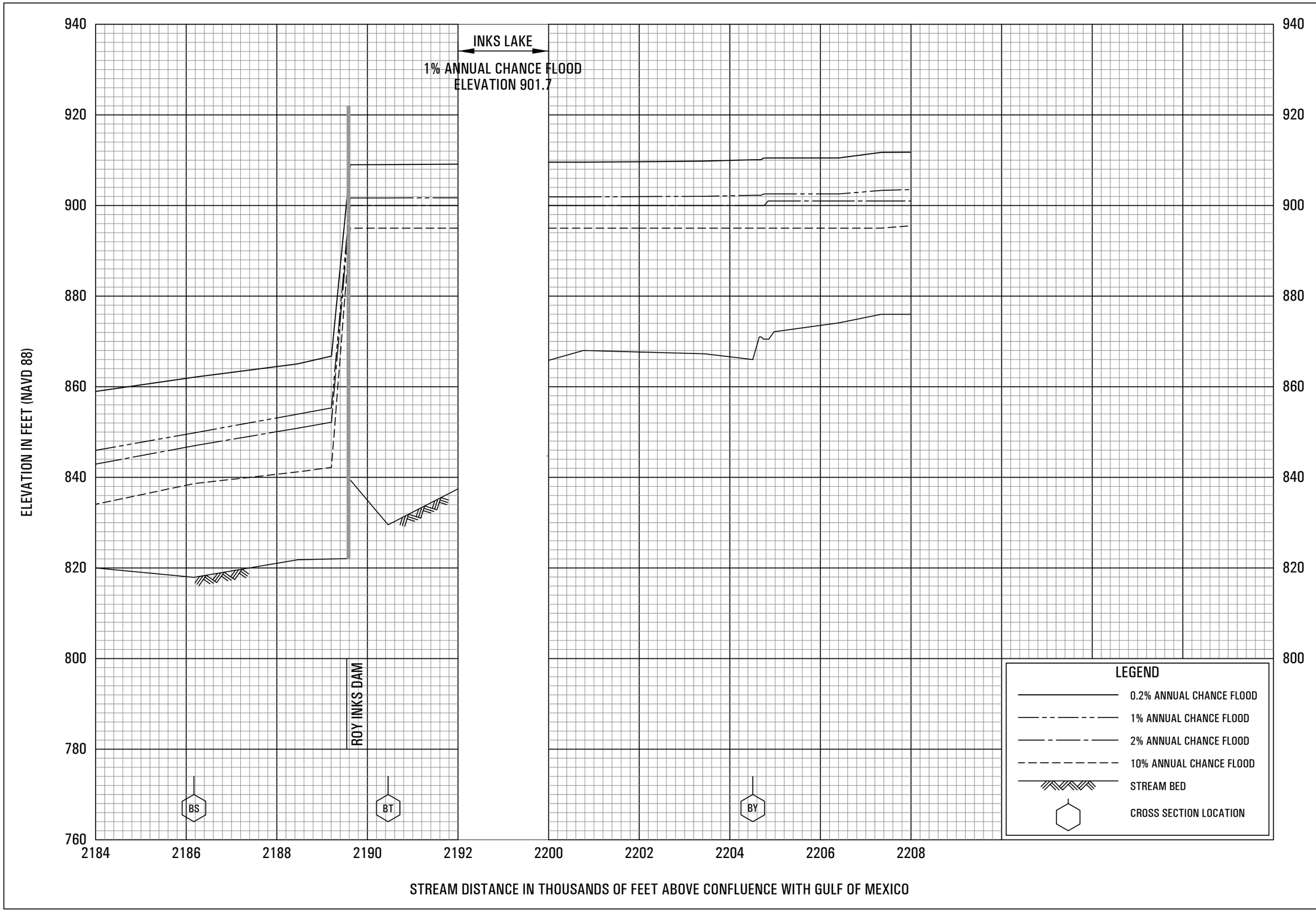

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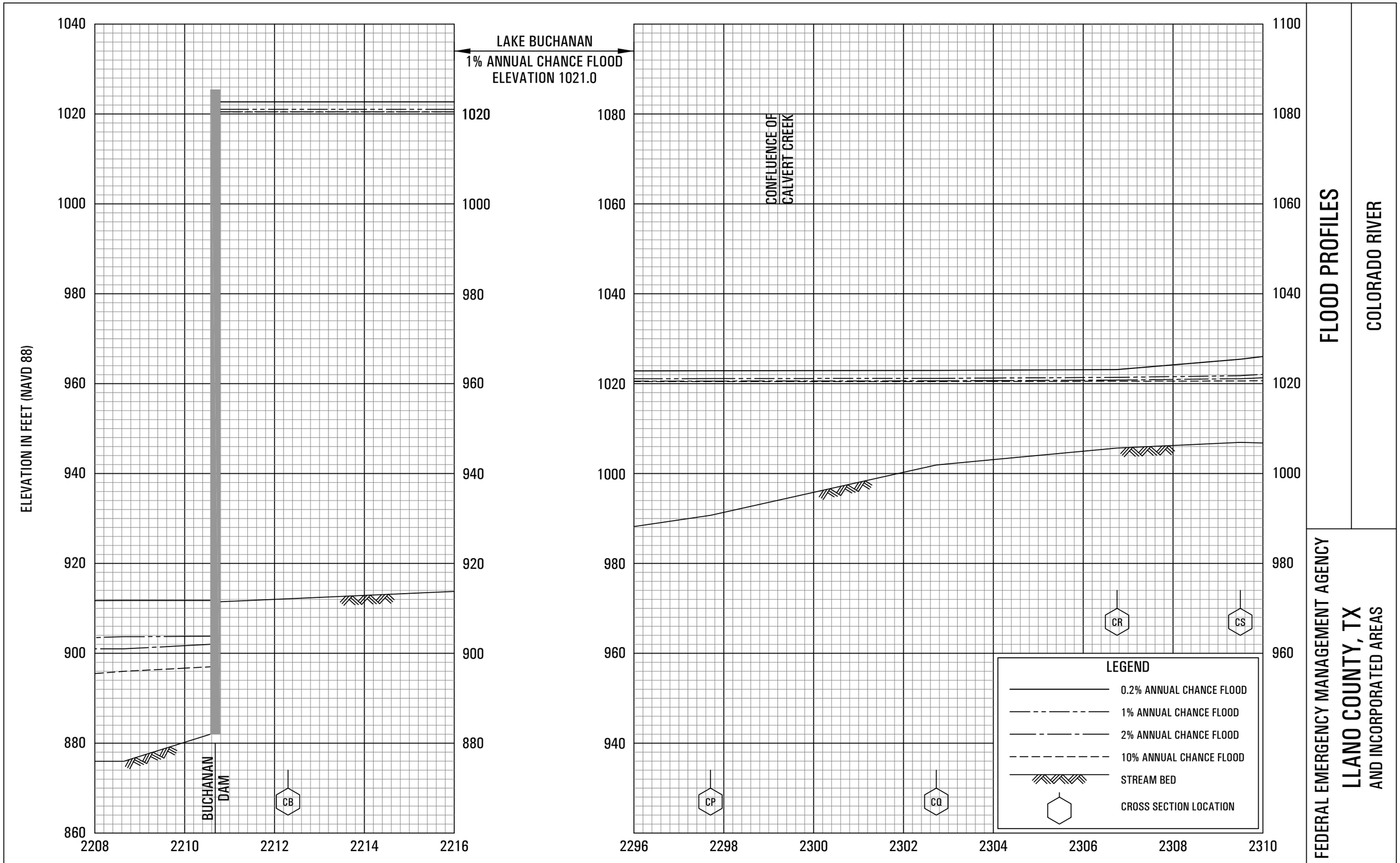

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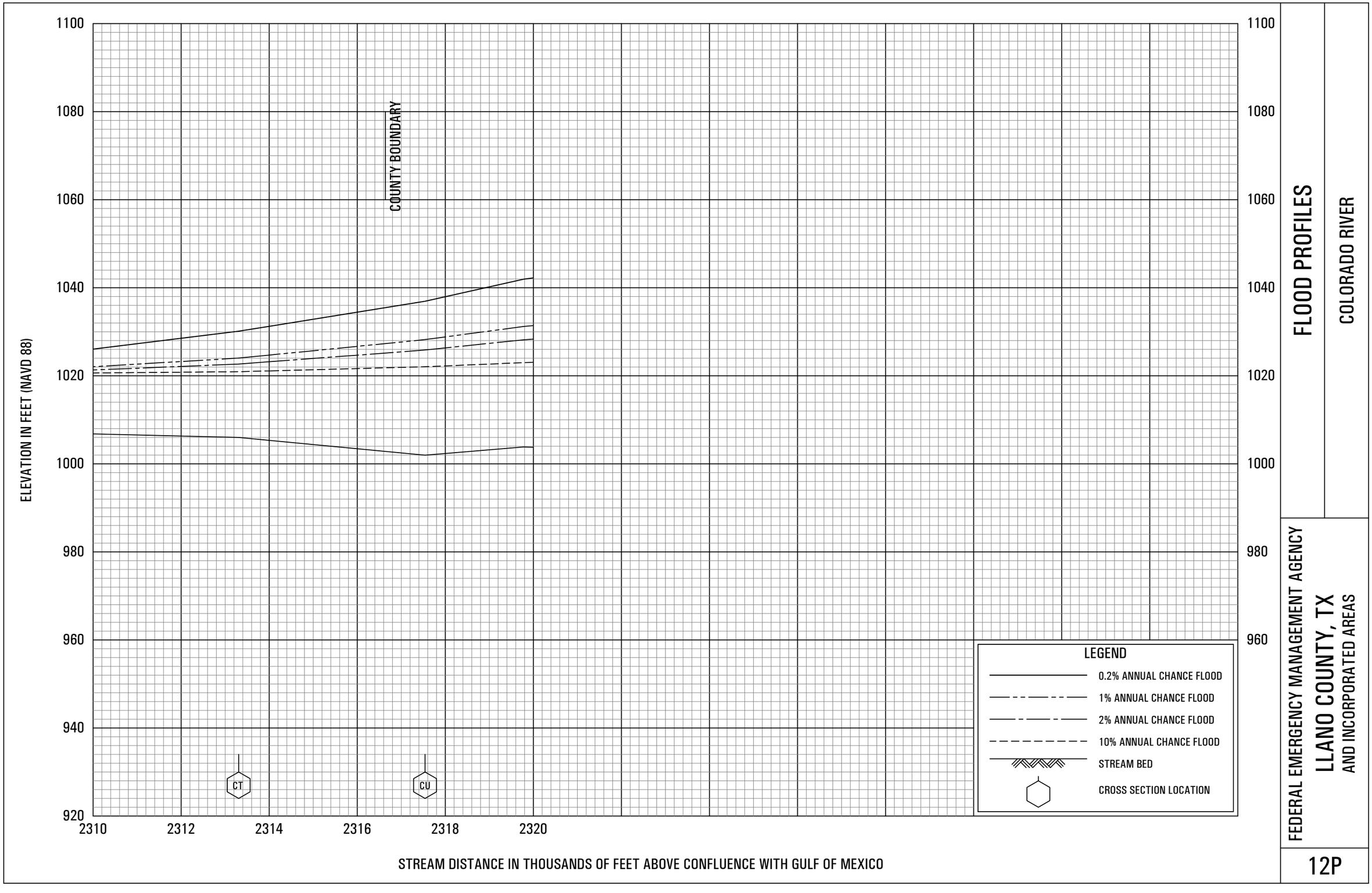

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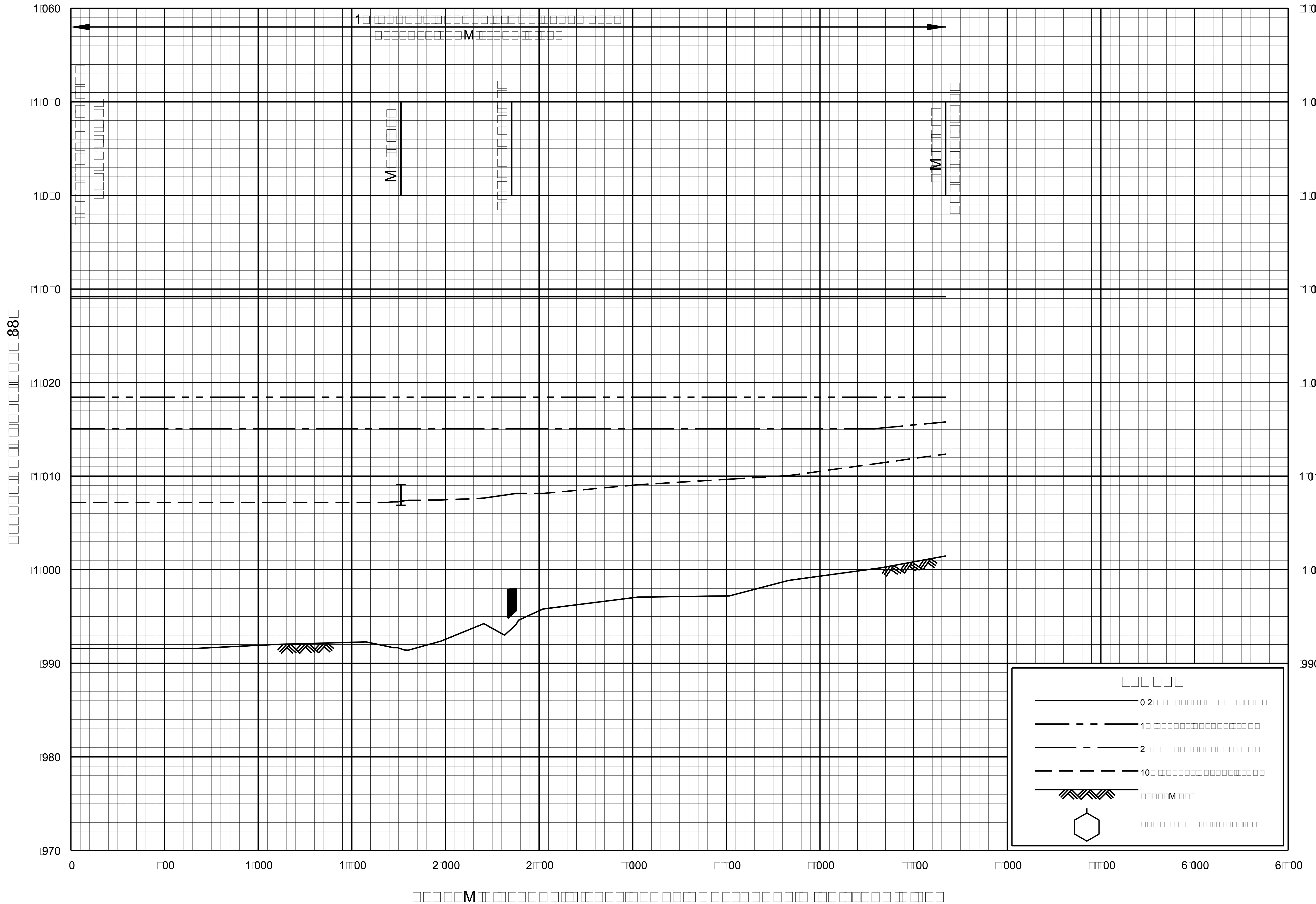

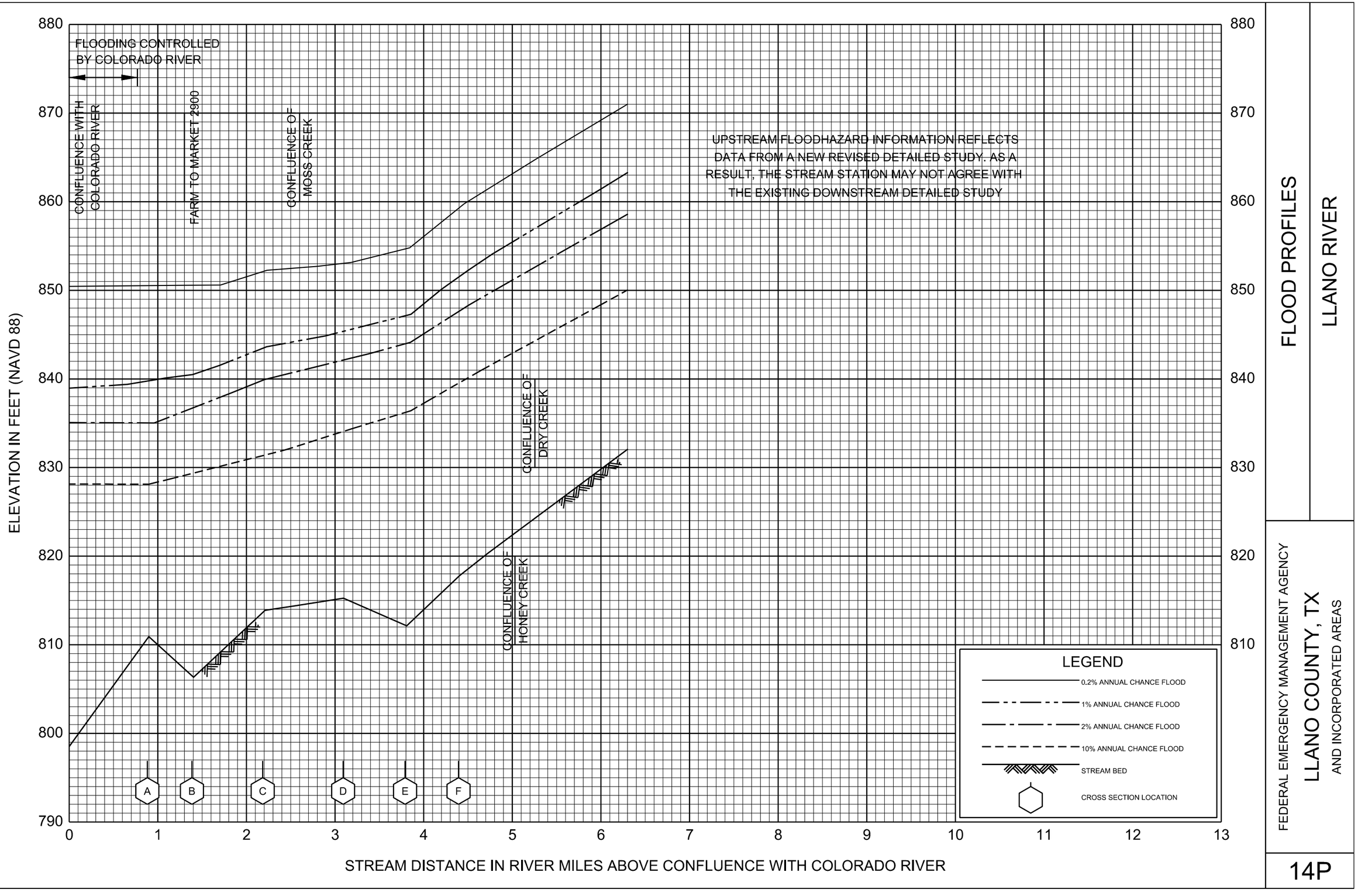

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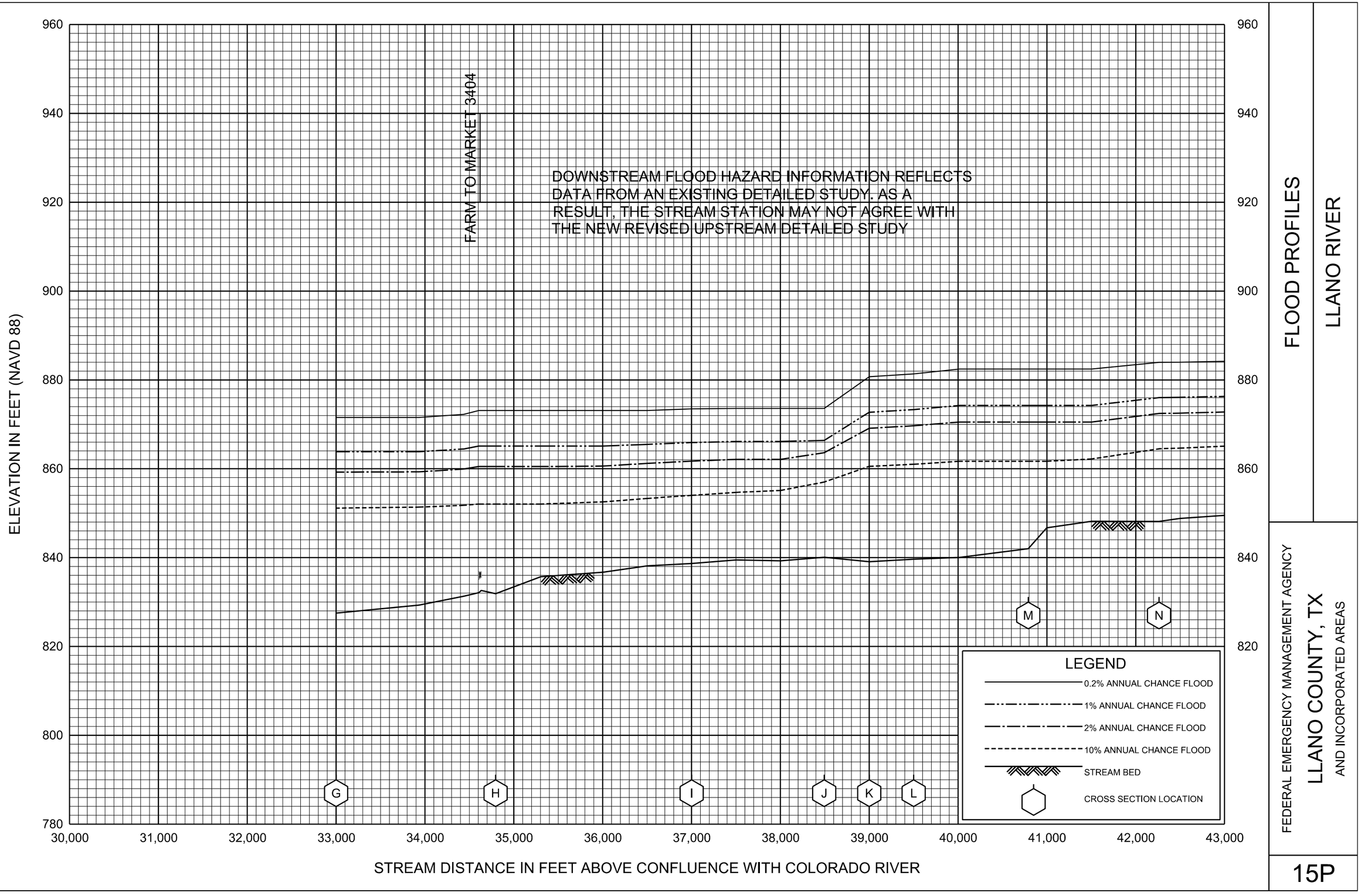

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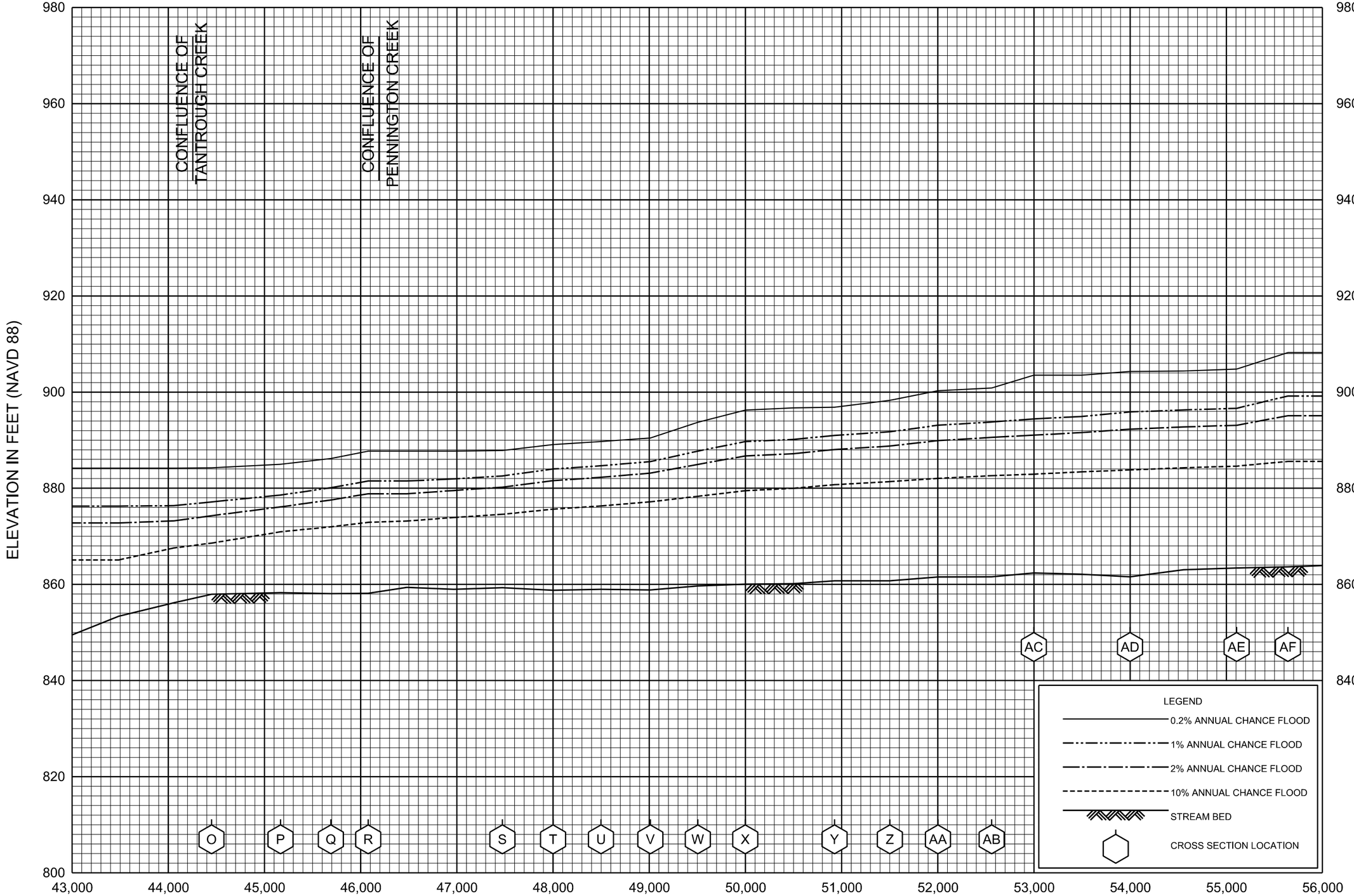

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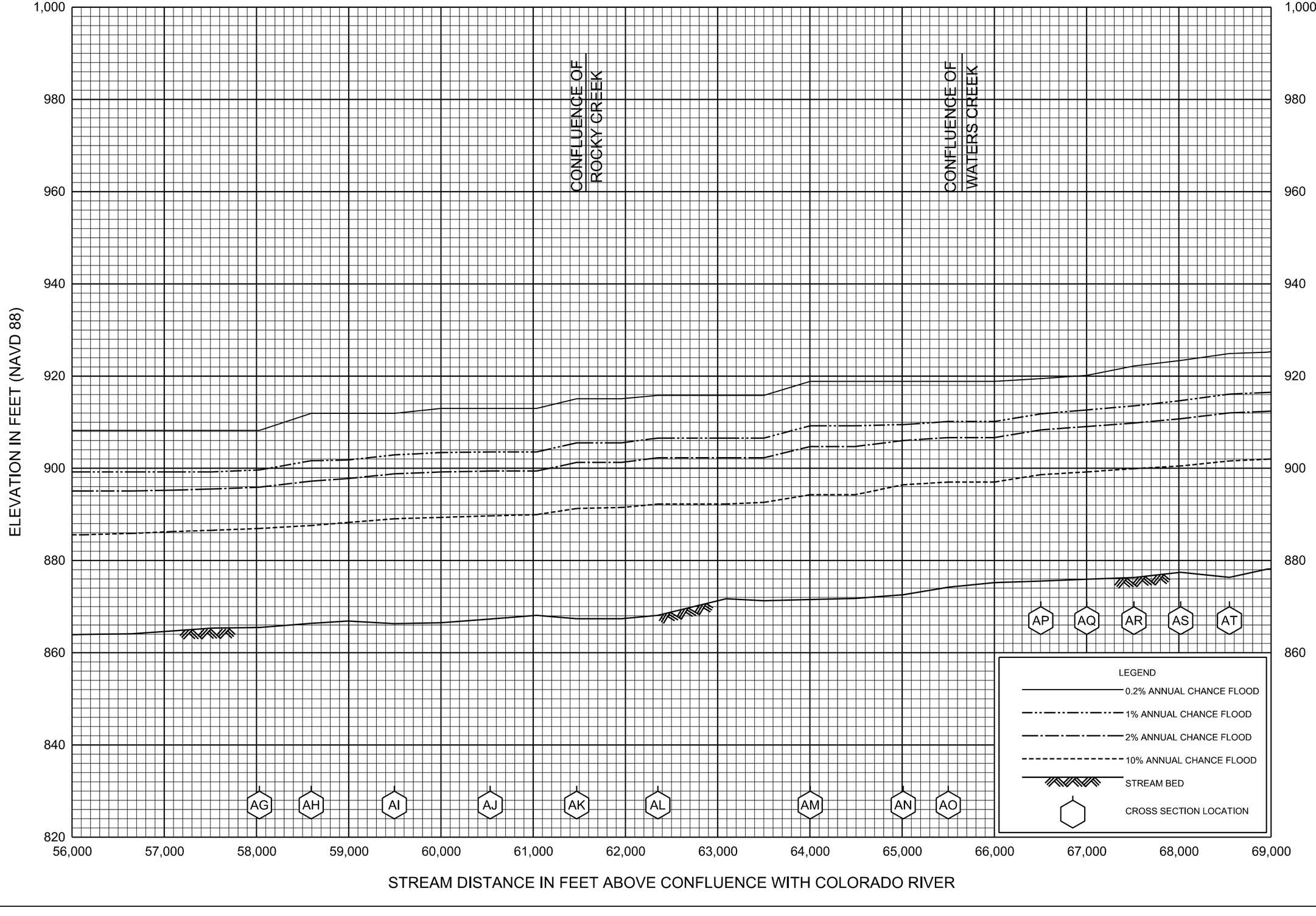

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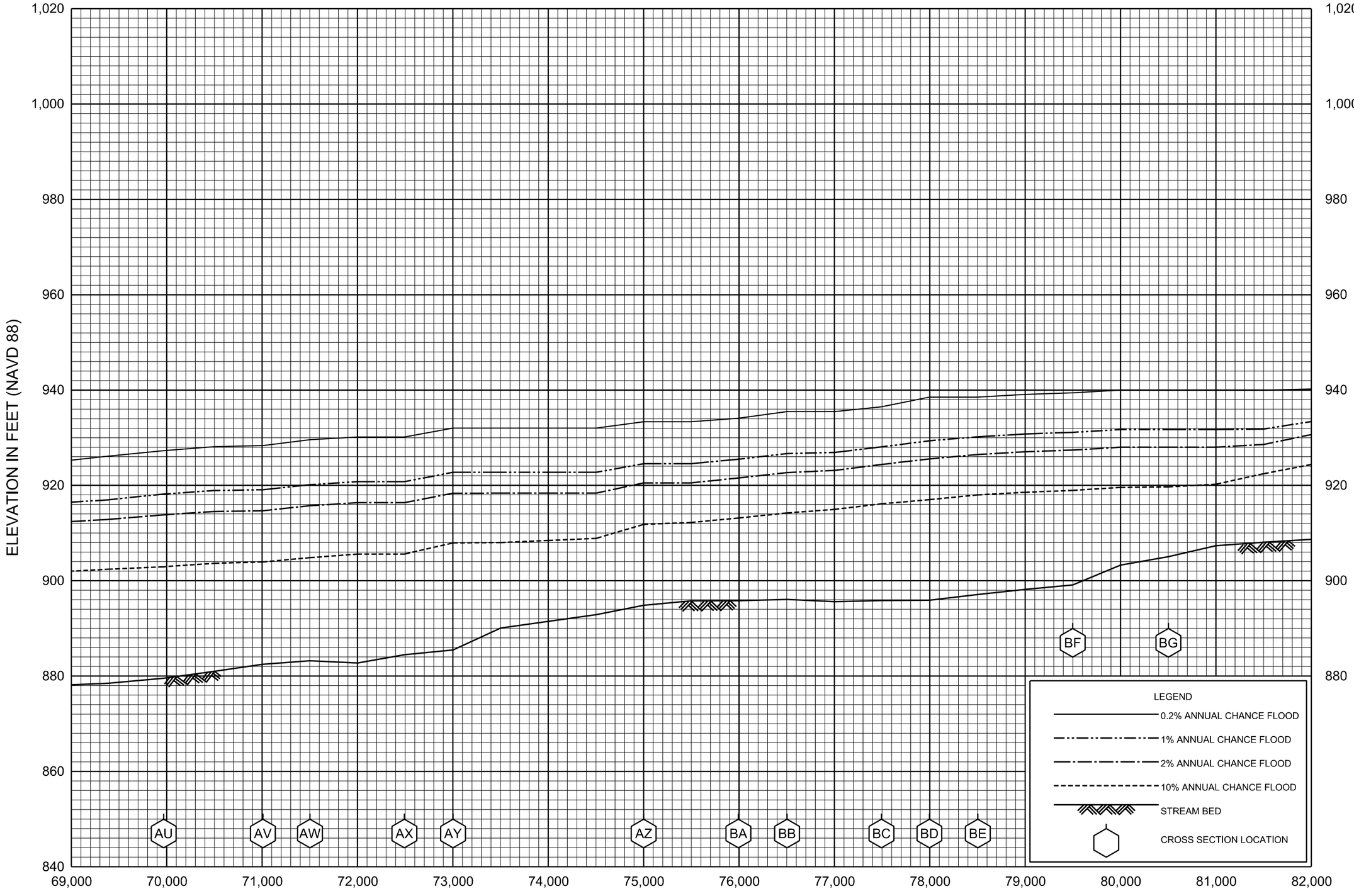

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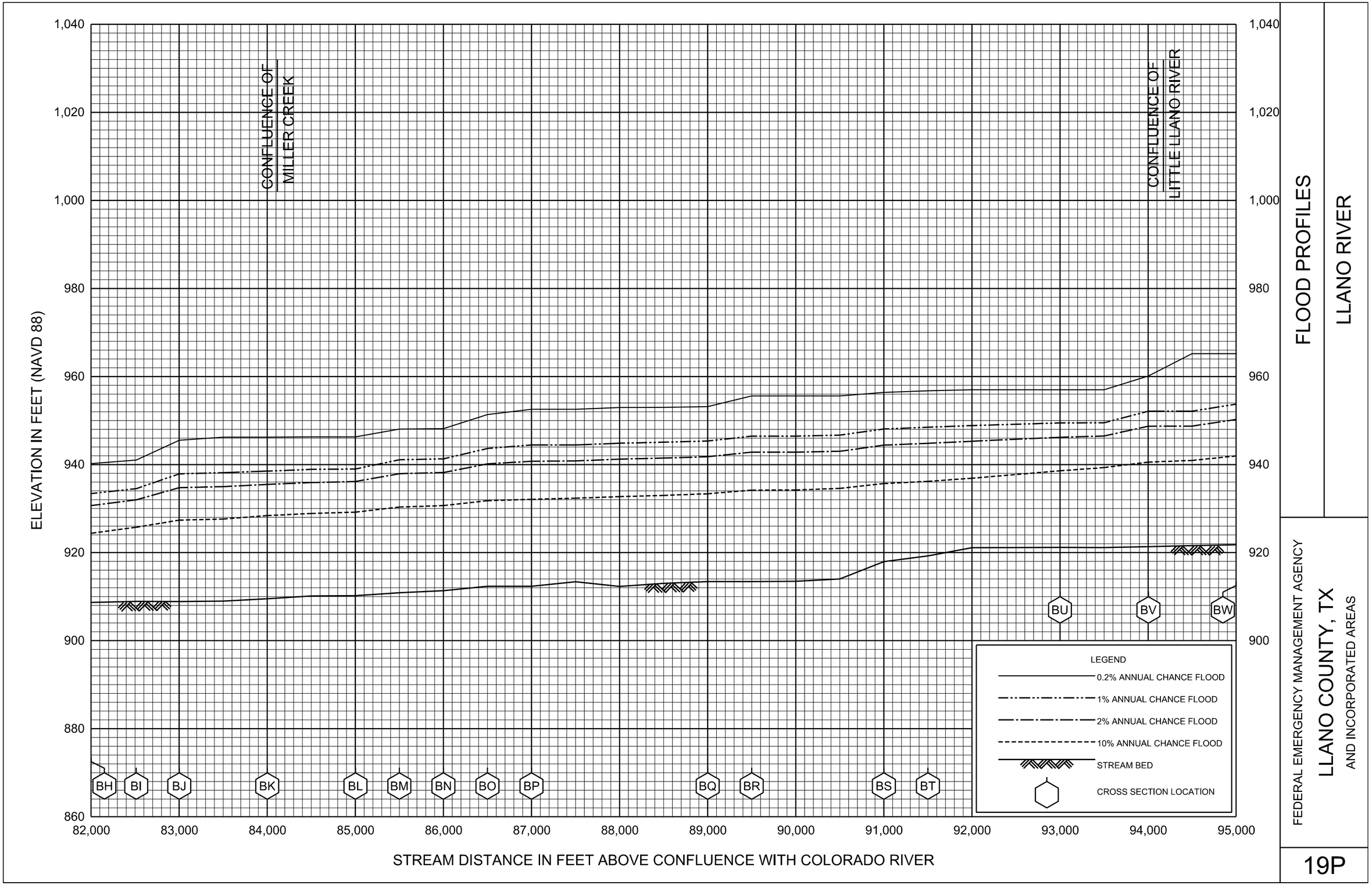

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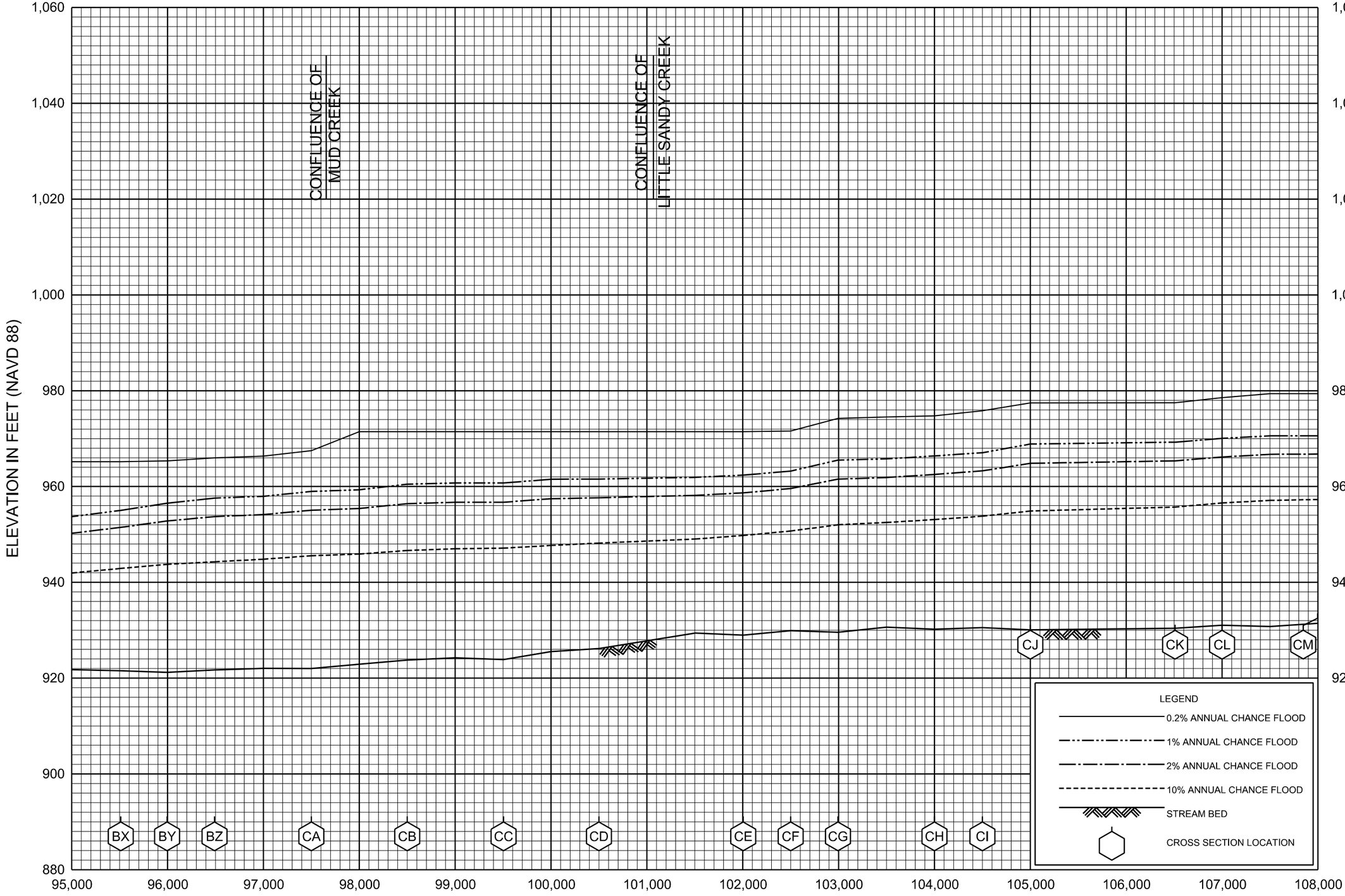

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AND INCORPORATED AREAS

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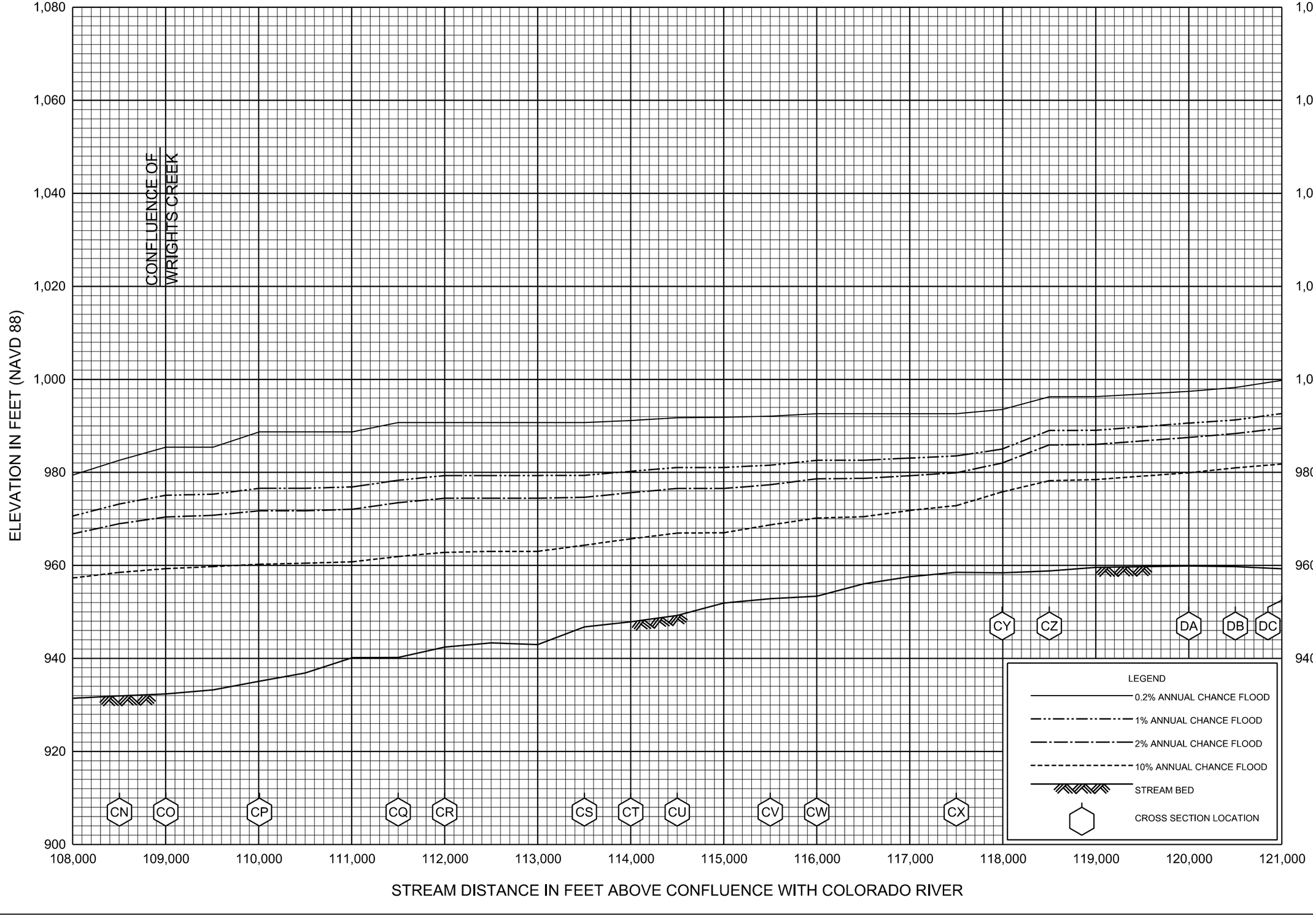


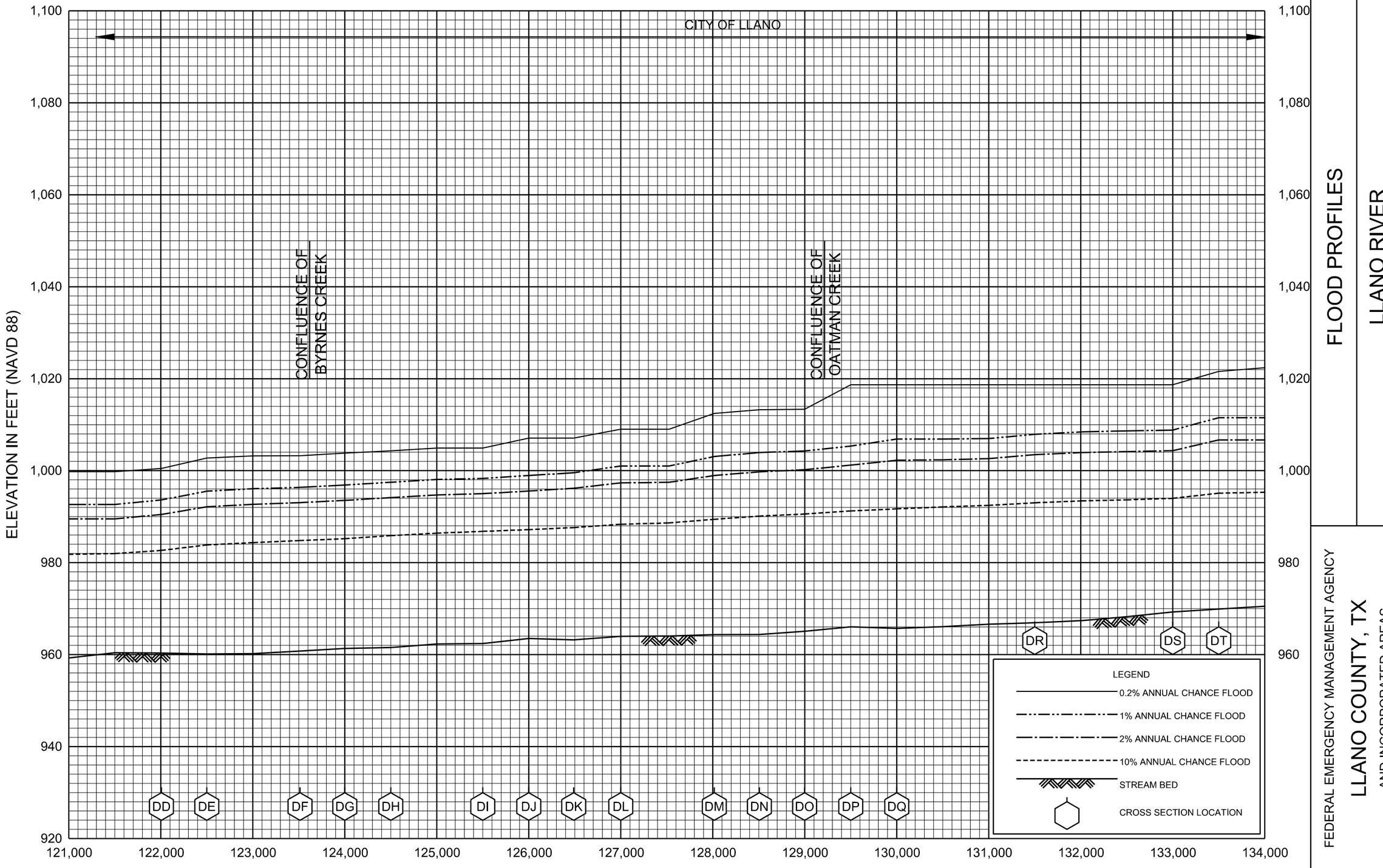
FLOOD PROFILES

LLANO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LLANO COUNTY, TX

AND INCORPORATED AREAS



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CITY OF LLANO

CONFLUENCE OF BUTTERY CREEK

BESSEMER AVENUE

LLANO DAM #1

CONFLUENCE OF FLAG CREEK

LLANO DAM #2

CITY OF LLANO

ELEVATION IN FEET (NAVD 88)

1,120
1,100
1,080
1,060
1,040
1,020
1,000
980
960
940

134,000 135,000 136,000 137,000 138,000 139,000 140,000 141,000 142,000 143,000 144,000 145,000 146,000 147,000

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH COLORADO RIVER

DU DV DW DX DY DZ EA EB EC ED EE EF EG EH EI EJ EK

LEGEND

- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

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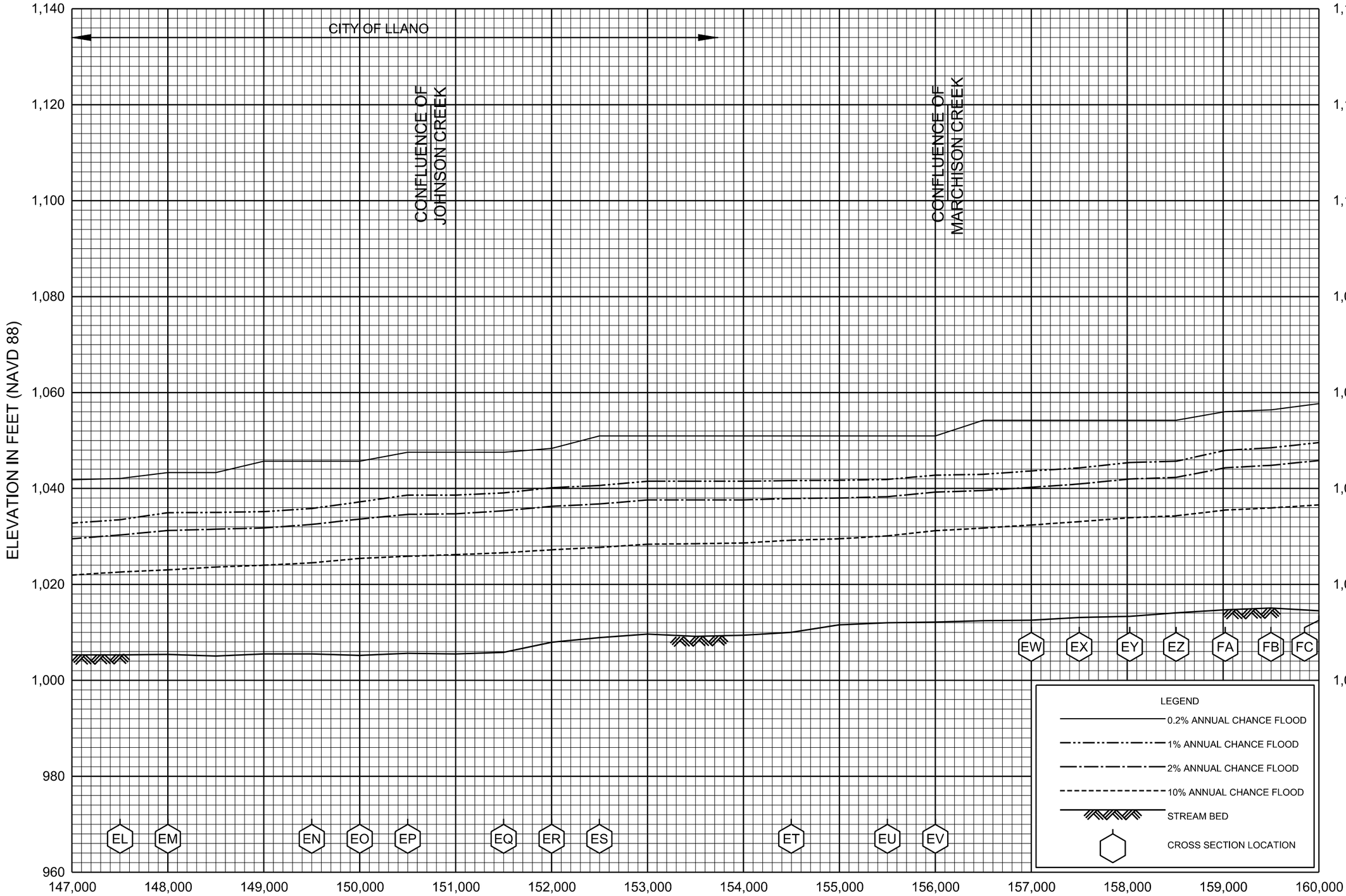

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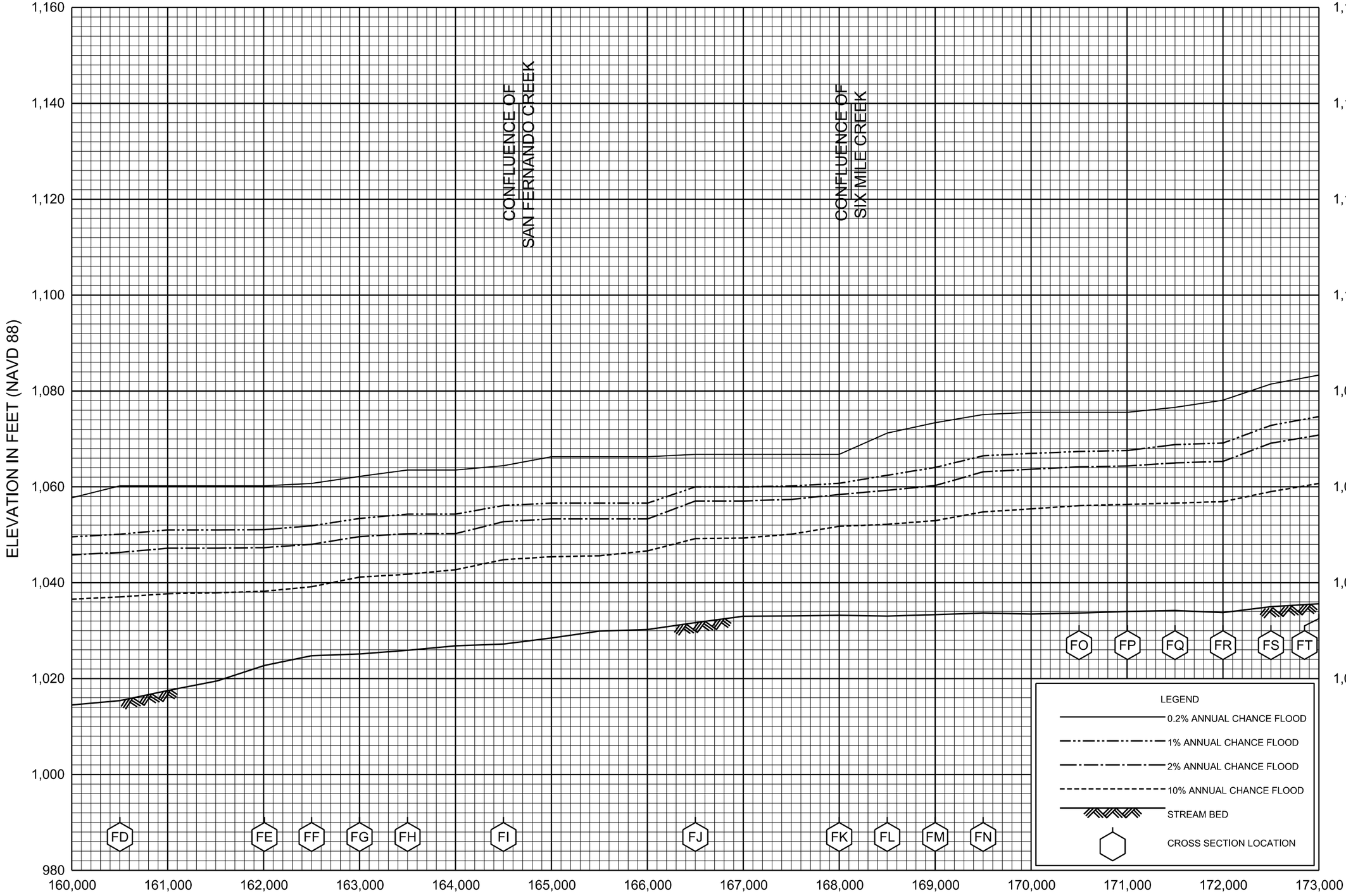
24P



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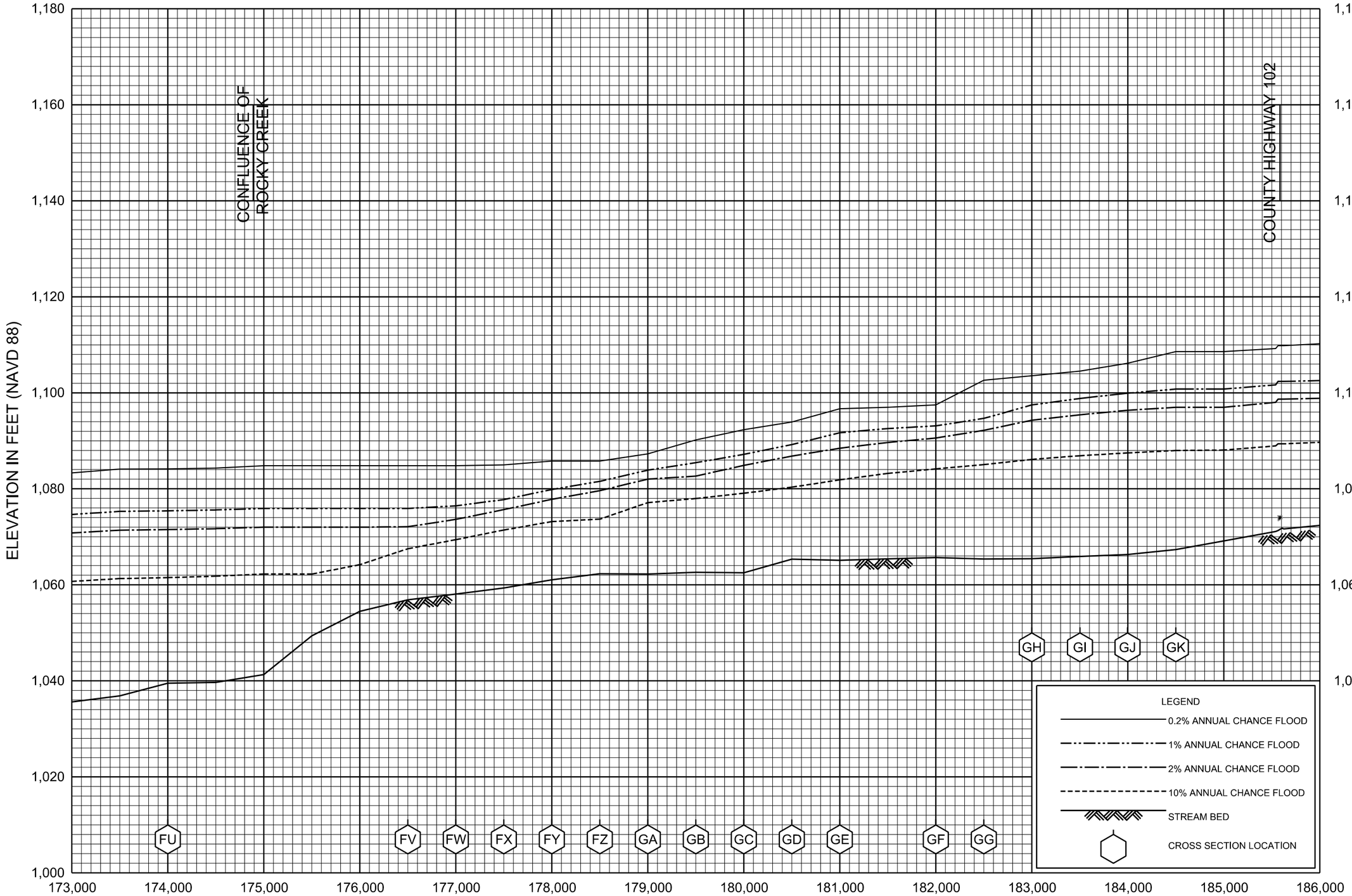
25P



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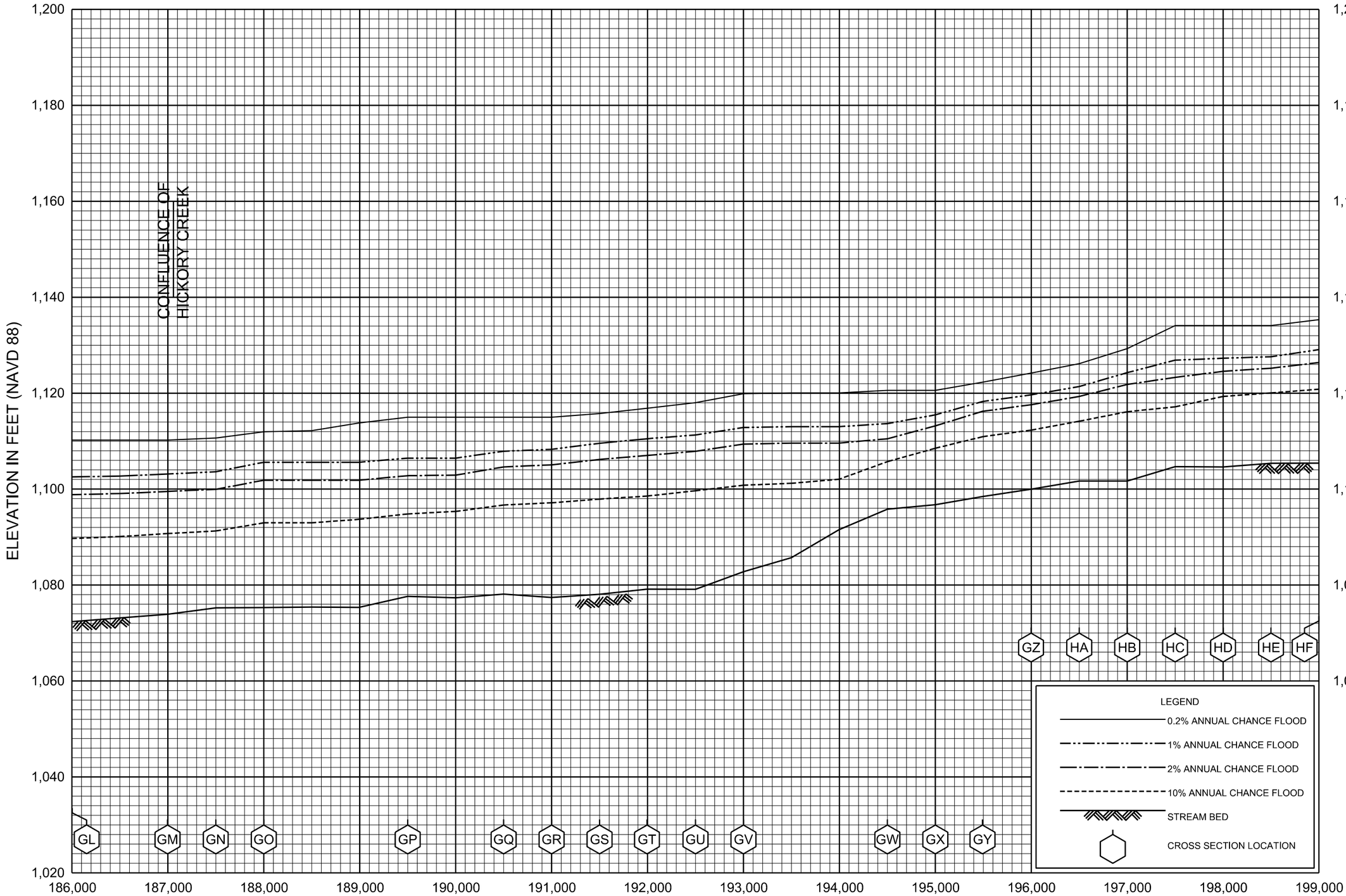

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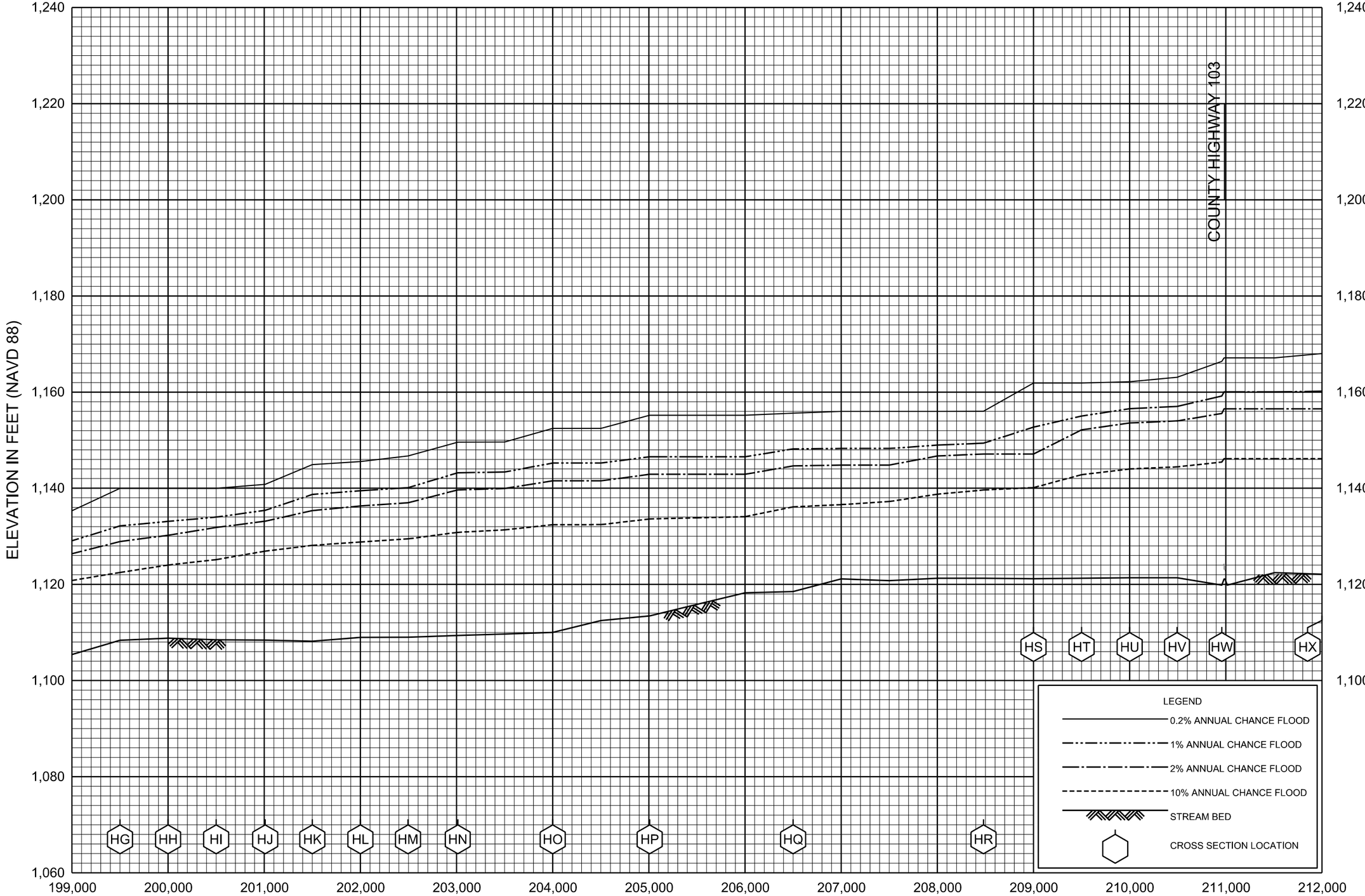
27P



FLOOD PROFILES

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LLANO COUNTY, TX

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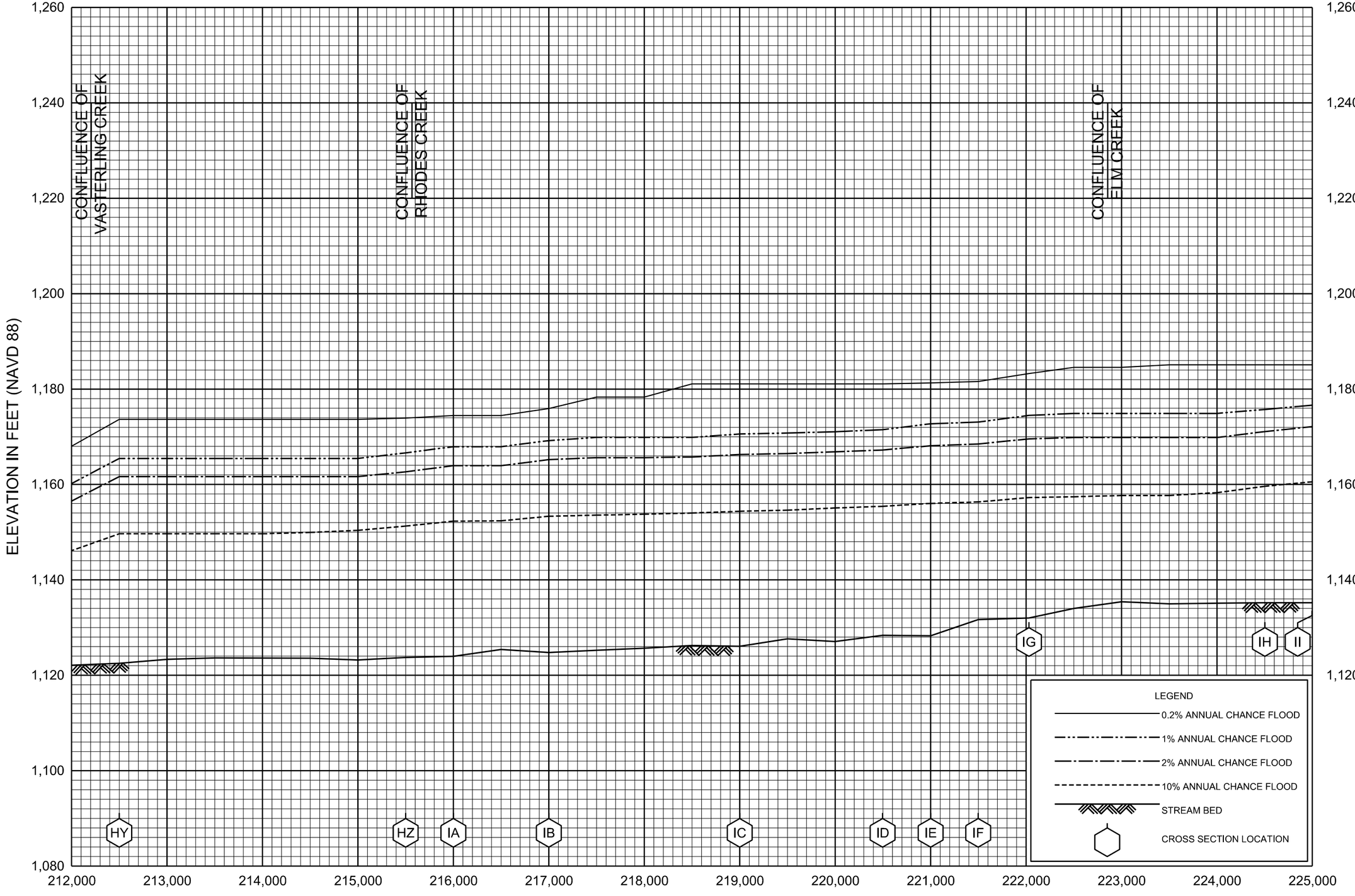
28P



FLOOD PROFILES

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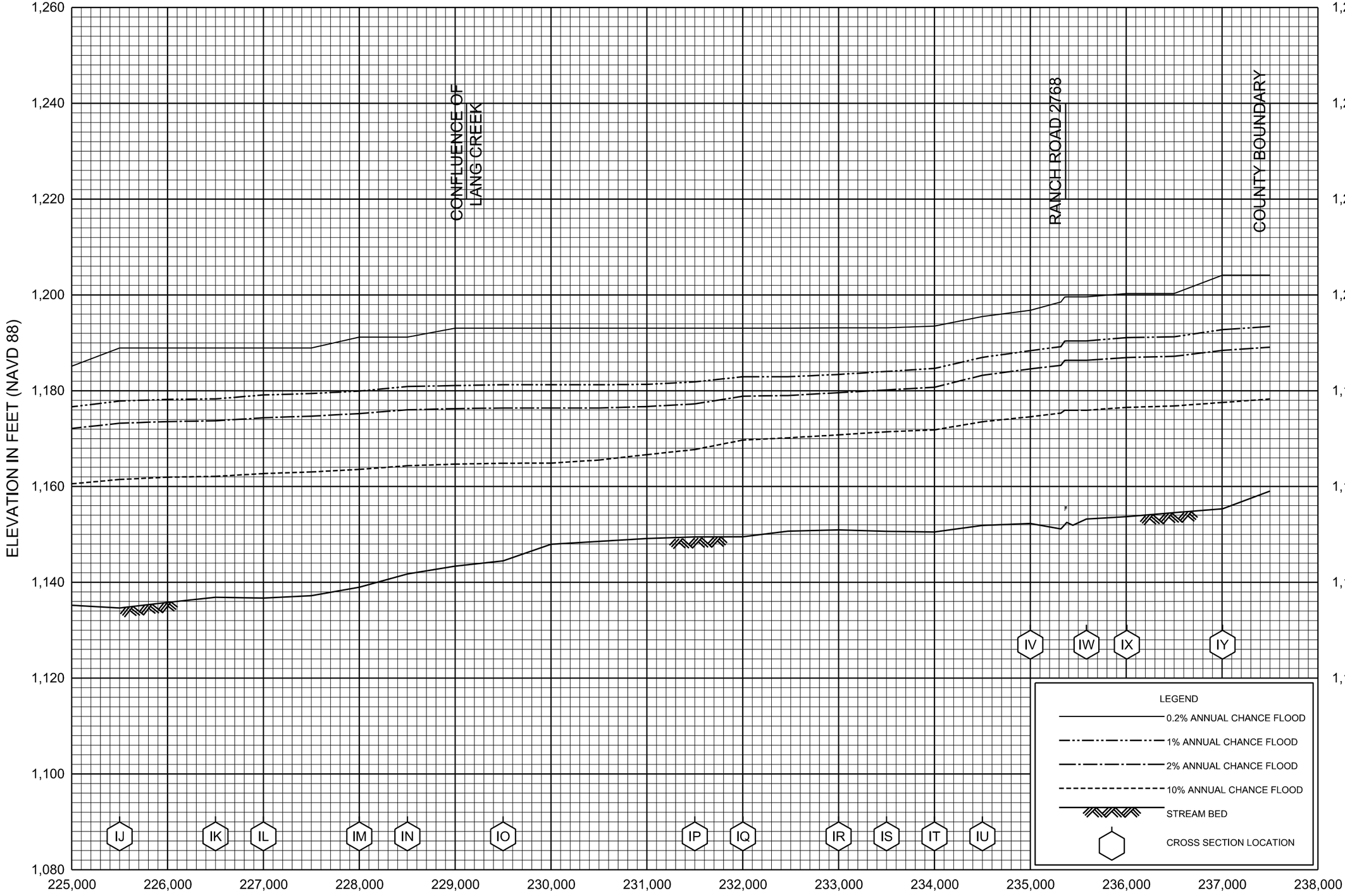
29P



FLOOD PROFILES

LLANO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LLANO COUNTY, TX

AND INCORPORATED AREAS

30P